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ANNALS OF SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

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ORIGINAL MEMOIRS.

A FURTHER CONTRIBUTION TO THE STUDY OF PERICOLIC MEMBRANOUS FILMS AND BANDS.

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IN a paper which was published in the ANNALS OF SURGERY, for January, 1912, after a study of a limited number of cases which had been observed by me personally, and a review of the literature of the subject, I formulated the conclusion that right-sided pericolic adhesions and membraniform veils and bands formed a fairly distinct pathologic entity deserving recognition as a well-defined surgical condition. As to the etiology of these films and bands, it seemed to me most probable that they were the result of long-continued or oft-repeated mild infections of the peritoneal covering of the cæcum and appendix transmitted through the intestinal wall. Since that paper was written, I have had an opportunity to observe additional cases, and it is upon the facts elicited in these cases that I wish to base some further observations. In the period of time that has elapsed since the publication of my paper, there have also been published a number of important contributions upon the subject, including papers by William J. Mayo, F. G. Connell, Joseph R. Eastman, Jabez N. Jackson, Isaacs, Coffey, Flint, and others. In my first paper, in giving credit to those who had contributed to the development of knowledge upon the subject, I was unfortunate enough to have overlooked the observations published in 1905 by Professor Binnie, of Kansas City, in which, under the name of pericolitis dextra, the condition now

under consideration was for the first time very clearly described.

In all of these contributions the question of the etiology of these membraniform conditions has received attention. Special importance must be attached to the observations of Professor Flint, made in a series of human embryos and of two infants at term. His conclusion is that they are not the products of inflammation nor are they due to the burrowing of the cæcum behind the parietal peritoneum. In his view they represent simply a more marked attachment of the large intestine to the posterior abdominal wall, or in some cases the more extensive fusion of the omentum to the colon, which is dragged down with the descent of the cæcum and gives it an attachment on the colon continuous with an embryonic membrane. He further concludes that the condition is much more frequent than we have suspected; that in many instances it produces no inconvenience; that it is only after the super-vention of other causes, as ptoses or inflammatory conditions, that they become a source of disturbance and discomfort.

The observations of Professor Flint are of sufficient importance to stimulate investigators, especially those who have the control of material involving embryos or new-born children, to specially examine with reference to this condition. Along this same line are to be noted the observations of Dr. Joseph Rilus Eastman, who found in 5 out of 28 fœtus a condition described as a peritoneal fold arising from the left or inner side of the ascending colon which passed over the anterior aspect of the ascending colon in an upward slanting direction to be attached to the parietal peritoneum at the right of the ascending colon. This fold may adhere to the anterior and lateral aspects of the colon. These folds exist before birth and are readily demonstrable in one form or another, according to Eastman, in approximately 20 per cent. of fœtus after the sixth month. Dr. Eastman, however, is careful to note that not all anomalous membranes which have been designated as Jackson's membranes are fetal structures, but expresses the opinion that mechanical irritations and long-continued and oft-repeated mild infections of the peritoneal

covering of the cæcum and appendix fit in well with the explanation of the embryonal origin of these membranes, since their fusions, adhesions, and contractures are doubtless directly or indirectly due to inflammation, so that the final solution of the problem of the origin of the conditions known as Lane's kink and Jackson's membrane will properly be represented by the sum of the views of various observers.

My original paper was based upon a study of six cases in which membranous formations, covering in varying degrees some part of the colon, and crippling its function more or less, were found present when the parts were exposed by abdominal section. For the purposes of an orderly and complete presentation of the material thus far accumulated, I will here give a condensed abstract of these cases as follows :

CASE I.—A woman over forty years of age, the onset of whose symptoms dated back only three months from the day when operation showed her to be the subject of a chronic appendicitis and membranous pericolitis. A right-sided perinephritic infection complicated this case, which was most plausibly explained as due to infection carried by the lymphatic paths from the region of the cæcum and ascending colon.

CASE II.—A woman twenty-four years of age, who in addition to a definite membranous film covering the cæcum and ascending colon was the subject of chronic appendicitis, chronic salpingitis, and chronic ovaritis.

CASE III.—A man, thirty-seven years of age, who as a youth or young man had enjoyed good health and displayed more than the average activity and energy in his work. When he was thirty-two years of age, an acute appendical attack ushered in the symptoms of right-sided disturbance, which were not relieved by the removal of the appendix, and persisted for five years, until he came to operation.

CASE IV.—Patient was a large, athletic, and finely developed man, who had always pursued an outdoor occupation. At the age of twenty-seven he developed an acute appendicitis, for which he was operated upon, making an apparently uncomplicated recovery. From that time, however, began a train of symptoms running through a period of seven years until he finally came to operation

at our hands, when there was found to be present a double-barrelled shotgun arrangement of the colon, the elements of which were bound together by a membranous envelope to which were added strong lateral bands confining the mass to the lateral parietes.

CASE V.—A lady thirty-two years of age, who, when she was twenty-eight years of age, first began to suffer from pain in the right iliac fossa. After a year of suffering her appendix was removed and she made a good operative recovery. Nevertheless her right-sided pains continued. In this case at operation the cæcum and ileum were found to be bound together, and the ascending colon to be constricted by distinct bands which were parts of a general membranous film covering in the ascending colon.

CASE VI.—A woman fifty-one years of age, who had long been an ailing neurasthenic woman. It had been recognized that she was suffering from certain positive pelvic conditions, but after these were corrected by proper measures she continued to ail. Her appendix had not been removed. It was found, however, when exposed at operation to be the seat of a long-standing chronic inflammatory process, associated with membranous bands, which not only bound it to the cæcum and adjacent ileum but were also continuous as membranous films which bound together the ascending and first portion of the transverse colon as two barrels of a double-barrelled shotgun (cf. Case IV).

These cases constituted the sum of our experience up to October, 1911. In the period of time which has since elapsed the number of these special cases has considerably increased, partly, perhaps, because we are looking for them and have learned to recognize them. The number, however, is not yet so great but that the recital and analysis of individual cases is still important. Up to the end of the present hospital year terminating March 31, 1913, these additional cases number nineteen in all. The following is a somewhat full abstract of their several histories and the pathological findings.

CASE VII.—*Right-sided pericolic bands not causing symptoms; constriction of colon distal to splenic flexure by band formed by adherent cecoploic appendage.* (Hospital No. 233.)

Male, seventy-five years of age. Had been a hale, vigorous, and active man. Four years ago he had an acute digestive disturbance accompanied with vomiting and purging. Two years later he began to experience in the splenic region a vague sense of discomfort which has continued to the present time. At irregular intervals there would be exacerbations of pain with an accumulation of flatus in the colon and constipation, culminating in a diarrhoeal attack after which relief would follow for an indefinite time.

During the month immediately previous to coming under our care this condition of intestinal irregularity had been quite marked. All his trouble subjectively was localized in the region of the splenic flexure. The tendency to constipation was marked. When cathartics were taken and these were effectual in moving the bowels, relief to his subjective symptoms followed for the time being. Abdominal palpation was negative with the exception that there was a fixed point of moderate tenderness on the outer margin of the left rectus muscle half way between the umbilicus and the costal arch. A series of bismuth skiagraphs demonstrated an obstruction at the splenic flexure.

On November 16, 1911, the abdomen was opened by a five-inch longitudinal incision through the left rectus muscle from the costal margin downward. The transverse colon was exposed and traced to the splenic flexure. Just below the splenic flexure was brought into view a half inch wide band, encircling and constricting the intestine to such a degree that when a moderate angulation was added gas would not pass. Further examination showed this constricting band to have been formed by an epiploic appendage, the tip of which had been carried over the intestine and become adherent to the mesocolon in such a manner as to constrict the intestine. When this was divided and its ends reflected to either side the bowel at once ballooned out and all signs of obstruction disappeared. Further exploration downward along the sigmoid flexure was negative. In the right iliac fossa, which was explored by the hand introduced through the wound, pericolitic bands could be felt, but since these had not given rise to any symptoms, it was not deemed wise at that time to expose the aged patient to the dangers of the more prolonged operative proceedings which would be demanded for exposing and dividing them. Most notable, however, was the condition of

the peritoneal layer of the transverse colon from the point of constriction backward. Its surface was congested and was somewhat rough and granular in appearance, and at points presented a filmy deposit. To the mind of the observers the condition was strongly suggestive of the early stages of the formation of the more extensive well-developed, membranous films which had been demonstrated to be present on the right side. This reddened and granular condition of the peritoneum of the transverse colon was unquestionably a result secondary to the presence of the obstructing band near the splenic flexure. The adhesion of the tip of the epiploic appendage was itself an unmistakable evidence of the presence at a previous time in this locality of an acute infectious process.

Two years have now elapsed since this operation, and the patient has remained in vigorous health, free from his old obstructive symptoms.

CASE VIII.—*Posttyphoidal diffuse adhesive peritonitis; wide-spread intra-abdominal adhesions and pericolic films; chronic appendicitis; ileac kink; relief by separation of adhesions and removal of diseased appendix.* (Hospital No. 240.)

Male, thirty-seven years of age. A thick-set, neurotic man with tendency to obesity. Seven years ago had typhoid fever, which ran a course of seven weeks. Three years ago was confined for ten days by an attack, the chief element of which was pain referred to the right side of his abdomen. This gradually disappeared in its acuteness, but ever since that time he has had pain at irregular intervals referred to the same region. Four months ago he had an attack more aggravated than usual, which lasted for two weeks. His bowels are constipated, and whenever he is tired or has been exposed, he suffers from colicky pains in them. He also is subject to attacks of spasmodic pain referred to the pylorus. These attacks of pain are always preceded by a condition of constipation and are relieved when the bowels move. There is tenderness on pressure over the region of the appendix, which tenderness extends downward into the pelvis. There is some tenderness complained of over the pylorus.

Operation (December 7, 1911).—A four-inch oblique incision rather high in the right iliac region. When the abdominal wall had been divided no free peritoneal cavity was entered, but the subjacent intestines everywhere were found adherent to the parietal peritoneal surfaces. An entry, however, was effected between

the coils of intestine exposed by the incision, and these coils were drawn apart by dividing the delicate adhesive films connecting them until the ascending colon and the cæcum with the appendix were eventually liberated and uncovered. All these structures and the adjoining coils of small intestine and the parietal peritoneum were bound together by delicate but firm adhesive films, and the whole area presented many tortuous dilated capillaries. The appendix when identified was found passing downward and backward underneath the ileum and thence to the pelvis below, and was bound throughout its whole extent to the ileum by an adhesion film. It was the subject of a chronic inflammatory thickening. It was enucleated and removed in the usual manner. The ascending colon was traced up to the hepatic flexure, and the restraining film in a large degree removed from its surface. At this point operative interference was suspended and after toilet of the region had been made with hæmostasis wound was closed. Operative recovery was uncomplicated. Ultimate result, entire relief from the symptoms for which the operation had been performed. The patient's condition was unmistakably the product of acute local inflammatory attacks, the previous symptoms of which as detailed in his history are clear enough and are doubtless due to bowel changes consequent upon the typhoid ulcers when thirty years of age. To the eye of the operator many of the filmy areas exposed in this case were identical in appearance with those which he had seen in the other and less severe cases of pericolitis.

CASE IX.—*Definite pericolic membrane covering in the ascending colon, reflected from lateral parietes, with strong band-like process extending up to gall-bladder and right hypochondrium; appendix chronically inflamed, sharply angulated and bound to cæcum and adjacent ileum by strong band-like adhesions which kinked the ileum.* (Hospital No. 261.)

Female, thirty-two years of age. A neurotic young woman well nourished, who since she was eight years of age has been the subject of a series of digestive troubles. Throughout her history there has been a marked tendency to constipation. At the age of nineteen, 13 years ago, she had an attack of severe pain referred to the upper abdomen, which lasted for three or four hours and was followed by a sense of epigastric tenderness for several days. Two years later she had a similar attack. Seven years later she

had a much more severe attack. These attacks never were accompanied with jaundice. Since this last attack four years ago she has been very easily exhausted. Bowels have been markedly irregular. Six months ago had a transient attack of pain in the region of the appendix, which lasted for one week. Since that time she has had numerous similar but slighter attacks. During the four weeks previous to coming under our observation she had had continuous pain low down in the right iliac fossa. Examination elicited nothing in the pelvis nor in the epigastrium, but there was a general tenderness over the line of the ascending colon, with its maximum over the appendix.

Operation (January 20, 1912).—The abdomen was opened by a five-inch longitudinal incision through the right rectus muscle with its centre opposite the umbilicus. The gall-bladder upon exposure appeared normal, but there extended from it to the hepatic flexure of the colon a rather long, dense band of adhesion. After this band had been divided the exposed ascending colon was found to be covered by a rather thick membranous veil of adhesion binding it to the lateral abdominal wall. Running in this veil were many small venules. This veil was stripped off until the entire ascending colon was free. The wall of the cæcum was thickened but not covered by this membranous veil. The appendix was sharply angulated and confined by a short, thick meso-appendix, which was bound in with the head of the cæcum and the adjacent portion of the ileum by a fibrous band-like formation which constricted and angulated the ileum. These various structures were freed from each other, and the appendix removed. The appendix was found to be in a state of chronic inflammatory thickening. The operative recovery in this case was uncomplicated, and the specific relief from the symptoms from which she had suffered was very marked.

CASE X.—Vascular membraniform veil springing from right lateral parietes reflected over ascending colon; upper portion thickened into a distinct band constricting colon at hepatic flexure; chronic appendicitis; ileac kink. (Hospital No. 267.)

Male, twenty-one years of age. An active, athletic young man always enjoying good health until six months ago, when he took part in a long distance running race. He finished the race but was so exhausted by the effort that he was confined to his bed for a week thereafter. Since that time he has been subject to frequent

colicky pains referred to the right hypochondrium, coming on an hour or so after eating. There was a tendency to constipation of the bowels, but he has been able to accomplish a daily stool. He now complains of slight tenderness over the appendix and of discomfort in the right iliac fossa at times, especially after exertion. Examination shows a marked rigidity of the right lower rectus muscle with some tumefaction in the region of the cæcum and ascending colon, with tenderness upon pressure.

Operation (February 28, 1912).—Usual three-inch longitudinal incision along the outer border of the right rectus muscle. The ascending colon when exposed was found covered by a membraniform veil springing from the lateral parietes and reflected over the ascending colon from the hepatic flexure down to the cæcum, but not covering the cæcum. This veil was quite vascular, and at its upper portion was so thickened that it formed a distinct band which immobilized the colon and constricted decidedly the intestinal lumen at that point. The appendix was, however, thickened and congested by chronic inflammation. The meso-appendix was thickened and from it extended a thick fibrous band which bound the appendix, cæcum, and ileum to the margin of the pelvic brim. When this band was divided the whole cæcum was found to be freely movable. The mobility of the cæcum was still more accentuated when the upper membranous veil had been divided and stripped off. The raw surfaces left by the separation of the adhesions and the division of the bands were covered in by proper sutures as far as possible, the parts placed in the normal relations, and the wound closed. Operative recovery was uncomplicated. The ultimate result was an entire removal of the discomfort and disability for which the operation had been performed.

CASE XI.—*Colonoptosis; ascending colon at middle encircled and constricted by membraniform band; cæcum dilated and mobile; appendix elongated but not inflamed; colonopexy.* (Hospital No. 314.)

Female, twenty-three years of age. Patient a neurotic, high strung, but intelligent young woman, had suffered from various intestinal troubles for many years. She was subject to attacks of diarrhœa alternating with constipation. A characteristic condition of intestinal auto-intoxication had developed. From the age of fifteen she had been subject to spells of petit-mal. At the time she came under observation her bowels were fairly regular,

but with much flatulence and colonic cramps. Bismuth X-ray picture showed a very marked ptosis of the colon, the hepatic flexure falling down two inches below the level of the iliac crest, and the greater part of the transverse colon sinking into the pelvis.

Operation (May 20, 1912).—The abdomen was opened by a three-inch longitudinal incision through the right rectus muscle. When the ascending colon and cæcum were brought into view, a distinct, well-formed membraniform band was found encircling the ascending colon at its middle and perceptibly narrowing its lumen. The cæcum was much dilated, was freely mobile, and hung over into the pelvis. The appendix was large but apparently normal in texture. It was removed. The constricting band was divided and the cæcum and ascending colon were fixed above the crest of the ilium to the parietal peritoneum of the right side by three silk sutures which were introduced through the anterior longitudinal band. The transverse colon was then brought up and a series of chronic catgut sutures, six in all, were placed through all the layers of the transverse mesocolon, catching the omentum also below the colon and thence catching the anterior abdominal wall along a line two inches above the umbilicus. The result of these sutures was that the colon was slung from the anterior abdominal wall by a transverse omental hammock (procedure of Coffey). The wound was then closed. The patient made an uncomplicated operative recovery. The later result of the operation has been to give her great relief from her previous intestinal troubles and practically to transform her life.

CASE XII.—*Pericolic membranous reflection binding first portion of transverse colon and hepatic flexure to right parietes; hepatic flexure constricted; cæcum dilated; appendix chronically inflamed; gall-bladder inflamed and extensively adherent to duodenum; cystic duct impermeable.* (Hospital No. 369.)

Woman aged forty-six years. A vivacious, energetic woman, with a history that during the period of years between her twentieth and thirty-fifth year of age she had many attacks of supposed subacute appendicitis. These then ceased to recur and in general she enjoyed good health and led an active life for the succeeding ten years, although she was subject to attacks of so-called gastric disturbances. There was also a tendency to constipation. Five months before coming under observation she experienced a sudden attack of excruciating pain, which was referred to the right hypo-

chondrium. This was relieved by morphia hypodermically, but for some days thereafter the gall-bladder region remained very tender. Since the first attack similar ones of varying severity have continued to be experienced at intervals which have gradually grown shorter, until during the ten days immediately preceding her entry to the hospital they occurred every other day. Upon admission, in the interval between the attacks, there was no pain nor tenderness nor tumor to be felt in the region of the gall-bladder; there was no muscular rigidity; temperature and pulse normal; there was simply slight tenderness upon pressure in the region of the appendix and along the ascending colon, but she was in a state of panic, apprehensive of the recurrence of her attacks.

Abdomen was opened on September 7, 1912, by a five-inch incision through the right rectus muscle from the costal arch downward. The stomach, pylorus, and duodenum, first exposed, were found normal. The gall-bladder was thick walled and moderately distended. A dense band of adhesions united the lateral surface of the gall-bladder to the adjacent surface of the duodenum. Continuing the examination along the right side downward, there was brought to view a dense adhesion uniting the right border of the omental apron to the transverse colon, and the hepatic flexure of the ascending colon to the adjacent abdominal parietes. When this band had been divided and the parts separated, there still remained several well-marked narrow bands of pericolic membranous formation encircling the colon near the hepatic flexure. These were also divided. When the cæcum was exposed it was found dilated and the appendix elongated, thickened, angulated, and bound down by adhesions, the centre of a chronic inflammatory process. The appendix was freed and removed. After all raw surfaces had been covered over by peritoneal suture, return was made to the gall-bladder region. The adhesions between the gall-bladder and the duodenum were divided and the gall-bladder opened. Its interior contained a moderate amount of tarry mucus, no bile nor calculi. The inner surface of the gall-bladder mucosa presented the characteristic strawberry-like state of chronic cholecystitis. The gall-bladder fluid contained an abundance of *Bacillus coli communis* as determined both by smears and cultures. A drainage tube was inserted into the fundus of the gall-bladder and the operative wound closed. The patient made an uncomplicated operative recovery.

No bile at any time appeared through the gall-bladder drains. The fistula was kept open, discharging daily a moderate amount of colorless, glairy mucus. No return of her dreaded paroxysms of pain has ever taken place. Three months after the primary operation the operation wound was reopened and the shrunken gall-bladder was extirpated. An equally favorable recovery from this second procedure followed, and the patient returned to her home in the third week thereafter. She has continued well to the present time and states that her bowels are moving normally, in this respect more satisfactorily than for the previous 25 years.

CASE XIII.—*Hepatic flexure bound to cæcum by membranous film, angulating ascending colon; appendix sharply kinked and chronically inflamed.* (Hospital No. 376.)

Female, thirty-eight years of age. A quite adipose woman, decidedly neurotic, who 12 years ago developed presumed pulmonary tuberculosis with hæmoptysis, for which she went south and recovered. Always had an irritable stomach, with frequent attacks of nausea and vomiting and symptoms of pyloric spasm. Suffered from intestinal bloating due to flatus. Was never jaundiced; was always constipated. Recently she had developed pain in the bladder, with irritability and pain in the region of the right kidney. Urine was reported to have contained albumin. When she came under observation she complained of more or less continuous aching and pain in the region of the right kidney. She suffered from occipital headache, frequent vomiting, and dysmenorrhœa; was unable to walk and was a confirmed invalid. A cystoscopic examination of the bladder gave negative findings. Pelvic examination showed the cervix extensively lacerated and the body retroverted. Upon coming to operation, after curettage and repair of the cervix, a right lateral incision was made through the sheath of the rectus to open the abdominal cavity. By this there was exposed a membranous film binding the hepatic flexure down to the cæcum and kinking the appendix sharply. The membranous adhesions were freed and the ascending colon straightened out. The appendix was in a state of chronic inflammation and was removed. The skin incision was prolonged downward and toward the median line and a separate median abdominal incision was made through the deeper structures above the pubis to expose the retroverted uterus. This was brought up out of the pelvis and its round ligaments plicated along its pos-

terior surface so as to swing it up in normal position (procedure of Webster). The patient made a smooth operative recovery and when discharged was greatly improved both in her mental and physical state.

CASE XIV.—*Proximal portion of transverse colon bound to ascending colon by dense membranous cover (double-barrelled shotgun arrangement); appendix chronically inflamed; gall-bladder inflamed and filled with calculi; liver prolapsed; stomach dilated and prolapsed; duodenum dilated and prolapsed.* (St. John's Hospital, Service of P. M. P.)

A woman, forty-four years of age, was admitted for relief of constipation and pain in the upper abdomen. During her whole life she had suffered from constipation and had always been afflicted with stomach troubles. Eighteen months before admission she suffered an attack of intense pain in the region of the gall-bladder, on account of which she was kept in bed several days. Later she had suffered regularly from pain in the epigastrium, starting about two hours after eating, which would be relieved by taking food. The constipation increased in degree and was attended with much flatulent pain. When examined the upper right rectus was tense and the stomach was dilated; no point of tenderness was elicited.

When the abdomen was opened the ascending colon and adjacent portion of the transverse colon were found bound down and covered over by a dense membranous veil, a typical membranous pericolitis. This veil was divided and reflected, freeing the colon and cæcum. The appendix when brought into view was found chronically inflamed and distended by fæcoliths. It was removed. The stomach was prolapsed and the duodenum was dilated two or three times its natural size. The liver was prolapsed, the gall-bladder was the subject of chronic inflammation and contained 16 calculi. The anterior edge of the liver was sutured to the anterior abdominal wall. Tube drainage of the gall-bladder was established and the wound closed about the drainage tube.

Subsequent recovery uncomplicated. Tube removed at end of twelve days.

In this case it was observed that the under surface of the ascending and transverse colon was perfectly normal, free from adhesions of any kind. The presence of the membranous for-

mation on the anterior surface of the intestine only might suggest a doubt as to whether it was originally caused by infection from the intestine.

Since this operation to the present time the patient has been able to eat anything in moderation, without any gastric or intestinal distress. Her bowels move naturally.

CASE XV.—*Cæcum confined by broad membranous veil, thickened to form dense band covering appendix and inserted into terminal ileum, forming pronounced ileac kink; appendix chronically inflamed; healed duodenal ulcer, with abundant adhesions between duodenum and gall-bladder.* (Hospital No. 394.)

A man forty years of age. In childhood was troubled with spells of repeated vomiting and attacks of so-called indigestion. Between the ages of twelve and twenty-five there were occasional spells of indigestion, followed by longer intervals of comfort. Twelve years ago began to suffer, especially after periods of much mental effort and concentration, from attacks of pain in the epigastric region. These would last from a few days to several weeks. The persistence of these attacks have greatly diminished his ability to discharge the duties of his avocation, which is such as to frequently demand great mental and physical exertion. Is subject to habitual constipation. Abdominal palpation elicits pain and tenderness in the epigastrium; otherwise negative. Test meals show hyperacidity which, however, is not always present. Examination of stool gives strong test for blood. X-ray examination indicates attachment of pylorus to the gall-bladder and liver.

Abdomen was opened through the right rectus muscle by incision extending from the free border of the ribs to $1\frac{1}{2}$ inches below the umbilicus. The omentum was adherent to the anterior abdominal wall. After this had been separated and the colon exposed, the cæcum was found held down by broad thin bands typical of membranous pericolicitis. The appendix was covered in by a strong band of adhesions which passed from the lateral parietal wall of the iliac fossa over the appendix and was inserted into the ileum $1\frac{1}{2}$ inches from the ileocæcal junction. This band held the ileum down and markedly angulated it. The appendix was also angulated, its tip adherent to the small intestine and the omentum. The appendix was in a condition of chronic inflammation. The adhesion bands were divided and reflected and the appendix removed.

Returning to the epigastric region the pyloric extremity of the stomach and adjacent duodenum was found attached to the gall-bladder and liver by abundant adhesions. Portions of these were developed into distinct bands which held up the duodenum. All these were broken up by blunt dissection. The gall-bladder when exposed was not much altered, nothing in its condition calling for intervention. Exploration of the jejunum did not develop any angulation or constriction. All the parts were replaced in as normal a condition as possible and the wound closed.

The patient made an uncomplicated recovery. The immediate relief from the constipation and pain from which he had been suffering was very marked. At the time of making the present report, ten months after the operation, the improvement has continued and the relief experienced has been such as to justify the operation made.

Analysis of this case suggests four individual factors as existing, namely, membranous pericolicitis, chronic appendicitis, ileac kink, and duodenal ulcer with consequent gastroduodenohepatic adhesions. The primary condition was due to the pericolitic formation, and according to the observations of Flint and Eastman may be accepted as having been embryonic in origin. The later conditions were secondary, infective in character, and creating a succession of lesions which reacted upon each other to produce the progressive pain and discomfort.

CASE XVI.—*Lower half of ascending colon and the cæcum constricted by membranous expansion which binds them to the lateral parietes; appendix buried beneath the membrane and chronically inflamed.* (Hospital No. 413.)

Woman aged forty-six. A fragile, neurotic woman who applied for relief primarily of symptoms produced by uterine myomata. She also complained of occasional discomfort referred to the right iliac region, accompanied by the formation there at times of a gaseous bunch. Abdominal palpation revealed in addition to the presence of a moderate myoma of the uterus deep tenderness over the appendix and over the gall-bladder. The abdomen was opened by a median incision extending from the umbilicus to the pubis. The cæcum and the ascending colon presented in a state of gaseous dilatation; their walls were congested. A broad, well-marked membranous adhesion constricted the lower half of the ascending colon and the cæcum, binding the intestine

to the lateral parietal wall. When this was divided and reflected and the ascending colon was drawn medially, the appendix came into view buried by the cæcum and covered by membranous folds. It was in a condition of chronic inflammation. It was removed. Two myomatous masses were then enucleated from the uterus. The raw spaces left after the various procedures were covered in by peritoneum and the abdominal wound closed as usual. Operative recovery uncomplicated.

CASE XVII.—*Membrane reflected from cæcum over appendix to peritoneum lining iliac fossa; appendix acutely inflamed; membrane congested.* (Hospital No. 415.)

A woman thirty-three years of age. Admitted with symptoms of acute appendicitis. Inquiry elicited a history that ten years ago she had an attack of acute pain in the right iliac fossa. Repeated attacks since that time. The last attack two years ago. Admitted with typical symptoms of acute inflammation of the appendix. When the abdomen was opened a generally congested cæcum presented, behind which was a mass fixing the cæcum to the iliac fossa, within which the appendix was buried. The appendix was enucleated in a condition of acute congestion. Associated with this congestion of the appendix there was a distinct membranous reflexion passing from the appendix over upon the lower anterior portion of the cæcum. In this ran many turgid venules. This membrane was distinctly organized and plainly differentiated from the inflammatory exudate in which the appendix was embedded. It was necessary to divide and reflect this membranous covering before the appendix could be enucleated. The appendix was removed by the usual method, the raw peritoneal surfaces covered in by suture. Uncomplicated recovery.

CASE XVIII.—*Cæcum covered in by pericolic membrane; meso-appendix continued upward on to terminal ileum, and by reason of inflammatory fixation of appendix into right iliac fossa constricting and making tense the ileum (obstructive ileac kink); dilatation of ileum; ulcers of duodenum and of stomach.* (Hospital No. 431.)

Man sixty-nine years of age, of apparent good general physical condition. For many years, however, he had suffered from gastric symptoms, consisting of spells of pain and burning and indefinite distress in the epigastric region, coming on three or four hours after meals, waking the patient at night. These attacks would be

relieved completely and immediately upon the ingestion of food and alkalies. After such attacks, varying from a few days to several weeks, there would be intervals of complete freedom from discomfort. During more recent years he has complained of fullness and aching in the region of the cæcum. During the two weeks immediately previous to admission he had passed several tarry stools. He was then seized with an acute prostrating pain referred to the epigastrium, with vomiting of large quantities of coffee-ground material. When admitted he was in a condition of shock, with weak pulse, 140, dyspnoea, distended and rigid abdomen, a tympanitic resonance in the hypogastric region, and with marked rigidity and tenderness in the right upper quadrant of the epigastrium. The abdomen was opened through the right upper rectus muscle. Several quarts of grumous material mixed with food were found in the peritoneal cavity. The pyloric end of the stomach was covered over by dense adhesions which fastened it to the posterior wall of the abdomen so densely that no liberation under the circumstances was possible. Just proximal to the pyloric vein on the lesser curvature was a patent ulcer the size of a ten cent piece, from which poured great quantities of grumous material. The ulcer opening was closed in by a row of Lembert sutures, over which was tacked the omentum. The peritoneal cavity was wiped out as well as possible. Counter incision was made on the right flank and one below the umbilicus for drainage. A drain was also left in the epigastric wound. The patient did not rally and died five hours after operation.

Upon postmortem there was found an old very definite pericolic membrane covering in the cæcum. The appendix, partially obliterated, was bound down to the right iliac wall by dense adhesions. Continuous with the meso-appendix was a proliferative fat laden mass of tissue which continued up over the ileocaecal junction and on to the ileum. This by reason of the fixation of the appendix to the right wall of the iliac fossa markedly constricted the lumen of the ileum. The ileum proximal to this constriction was markedly dilated. The wall of the gall-bladder, thickened, was covered by old inflammatory bands, its mucosa in a condition of chronic inflammation. The gall-bladder had been drawn down and become adherent to the upper surface of the duodenum and was involved in an old scar process which joined them to the head of the pancreas behind. The head of the pancreas

was hard and infiltrated. There were in this region many old cicatrices proximal to the pylorus. It was stenosed to an opening about $\frac{1}{4}$ inch in diameter. On the lesser curvature of the stomach there was a perforation the size of a ten cent piece, which opened freely into the peritoneal cavity. On the posterior inferior wall of the pyloric antrum extending to the pylorus proper was a perfectly healed, punched-out round ulcer. The pyloric sphincter itself had been replaced by scar tissue. On the duodenal side of the pylorus on the posterior wall was a third ulcer, the size of a ten cent piece, with clean edges, which had perforated completely through all the layers of the intestinal wall into the substance of the pancreas which formed its base. The stomach itself was dilated.

The sequence of pathological conditions in this case was evidently first, the pericolic membrane, the chronic appendicitis, the angulation and constriction of the ileum, secondary to which in course of years developed the conditions in the upper abdomen which led to the final catastrophe.

CASE XIX.—*Cæcum and appendix fixed in the right iliac fossa by a mass of adhesions of inflammatory origin, distinct from these a membranous layer covering the posterior outer surface of the cæcum and binding down the chronically inflamed appendix; first part of sigmoid flexure adherent to left brim of pelvis; old salpingitis.* (Hospital No. 438.)

Woman, thirty-five years of age. Applied primarily for relief from vesical irritability. Upon examination it was found that she had a patent urachus and that she also suffered from chronic endometritis, chronic salpingitis, and chronic appendicitis. She was the subject of habitual constipation, and suffered from accumulations of gas in the colon. She had been operated upon two years before for hemorrhoids. Cystoscopic examination of the bladder revealed no bladder conditions which accounted for her symptoms. The uterus was curetted. The persistent urachus was exposed by a longitudinal incision, isolated and extirpated. The tubes and ovaries presented evidences of former inflammation which had now degenerated into sclerosis. The head of the cæcum was bound to the right brim of the pelvis by a strong band of adhesions. After these had been divided the posterior outer surface of the cæcum was found covered by a distinct membranous layer, beneath which the appendix was imprisoned. This was

divided and the appendix, in a condition of chronic inflammation, was enucleated and removed. Examination of the descending colon showed the first part of the sigmoid flexure bound down to the left brim of the pelvis by fibrous bands similar to those on the right side. These were likewise divided until the sigmoid was set normally free. The conditions as found suggested the presence at some preceding time of an infection of both tubes, consecutive to which adhesions binding down the colon had formed. This, however, could hardly have caused the peculiar membranous layer covering the posterior outer surface of the cæcum by which the appendix was imprisoned.

An uncomplicated operative recovery followed with entire relief to the abdominal and digestive symptoms. The bladder has greatly improved but still at times is irritable.

CASE XX.—*General ptosis of abdominal viscera; head of cæcum covered by a pericolitic membrane which is reflected over a chronically inflamed appendix.* (Hospital No. 440.)

Woman, thirty-nine years of age. A sallow, slender woman, who has been married two years, never pregnant. Occasionally since childhood, at long intervals, she has suffered from spells of faintness without losing consciousness, attended by vomiting and a sense of soreness through her bowels. She has always been constipated; has never had any attack of severe abdominal pain, but there is a constant sense of discomfort on the right side of the abdomen. She is practically incapacitated from active labor on account of the early exhaustion and aggravation of discomfort following exertion. She complains of indigestion, of much belching of wind. Examination shows a general ptosis of the liver, stomach, and colon. The cæcum is dilated and tender, the right kidney moderately prolapsed, and the uterus retroverted and prolapsed. Abdomen was opened by longitudinal incision from xyphoid appendix to the umbilicus. The prolapsed stomach protruded through incision. Liver was prolapsed to the level of the crest of the ileum so that the appendix and gall-bladder were in contact. The cæcum was prolapsed to the brim of the pelvis. The appendix was behind the cæcum and covered in by a pericolitic membrane. The chronically inflamed appendix was enucleated from its bed and removed in the usual manner. The raw surface left by the enucleation of the appendix was sutured to the lateral parietes near the crest of the ileum so as to fix and

elevate the cæcum and descending colon. The liver was rotated upward to its normal position below the diaphragm, and its suspending ligament was shortened by pleating it with chromic gut sutures, which were inserted into the anterior parietes above the level of the costal arch. The anterior edge of the liver, at the entrance of the round ligament into the longitudinal fissure, was also included in these sutures. Similar sutures were passed, fixing the anterior edge of the liver on either side, fastening it to the diaphragm. The gastrocolic omentum and the greater omentum were then sutured to the anterior parietes above the umbilicus by a series of these chromic gut sutures arranged transversely.

At the end of six months after the operation patient reported that her bowels were acting regularly, some aperient being indicated only occasionally. All the right side symptoms had disappeared but she had had some trouble from accumulation of flatus at the splenic flexure (left-sided discomfort). Her general health has greatly improved, but she is quickly fatigued when on her feet.

CASE XXI.—*Ascending and first portion of transverse colon bound together by a membranous envelope, thickened at points into distinct bands (double-barrelled shotgun arrangement); cæcum, appendix, and terminal ileum bound down to brim of pelvis by strong fibrous bands; appendix chronically inflamed; ileum kinked.* (Hospital No. 441.)

Woman, forty-six years of age. Admitted primarily on account of menorrhagia and profuse and offensive discharge due to adenomyoma of the uterus. In addition to the pelvic condition, she suffered much from constipation and severe abdominal pain, the maximum of pain being referred to the cæcal region. Suffers much from gaseous eructations and from characteristic symptoms of fecal stasis. When admitted to the hospital the abdomen was flat and relaxed but with gaseous distention of the cæcum. The entire ascending colon and the cæcum were tender, with maximum tenderness at the site of the hepatic flexure. When the abdomen was opened, by a longitudinal incision from the pubis to umbilicus, the ascending and transverse colon were found bound together for some five inches of their course by strong membranous bands springing from the anterior surface of the omentum near its colonic attachments and inserted into the lateral aspect of the ascending colon. The cæcum and appendix were bound down to the brim of the pelvis by strong fibrous bands which involved

also the last two inches of the ileum. Hidden beneath this cæcoliac membrane was the appendix in a state of chronic inflammation. The bands were divided and appendix enucleated and removed and the raw surface covered over by peritoneum. Two large cysts of the left ovary were excised. Uterus removed in the usual manner. Patient made an uncomplicated recovery. Her health thereafter became markedly improved. She gained steadily in strength and spirits and was relieved of all troublesome symptoms.

CASE XXII.—*Ptosis of stomach; cæcum and ascending colon covered by membraniform veil, which at the hepatic flexure was thickened into a distinct band constricting the hepatic flexure; appendix chronically inflamed; from meso-appendix a band-like reflection passing to ileum and angulating it (ileac kink).* (Hospital No. 451.)

A female, sixteen years of age. A bright, active young girl, who from early childhood has suffered from frequent abdominal crises of pain, vomiting, and diarrhoea. An especially aggravated attack occurred six months ago. When she was eight years of age she had a continued fever for a period of six weeks, since which time her general malaise dates. Her bowels are constipated, menstruation regular. Examination reveals a narrow lower thorax and upper abdomen and a large lower abdomen and hips, giving the general conformation of an hour-glass. There is ptosis of the stomach. The cæcum is distended and tender. Marked tenderness over the appendix.

Abdomen was opened by longitudinal incision through the right rectus muscle. Over the cæcum and ascending colon there was a delicate, congested, membraniform veil. This was thickened as it approached the hepatic flexure and formed a constricting band which bound down and diminished the lumen of the colon at that point. The appendix was not covered over by the membrane, but was elongated, thickened, and congested, lying down upon the brim of the pelvis. From the meso-appendix there was a reflection which passed over on to the ileum angulating it (ileac kink). The appendix was removed. The ileac reflection of its meso was divided and the ileum freed; the pericolic band which constricted the hepatic flexure was divided; the ptosed transverse colon was fixed to the anterior abdominal wall above and to the right of the umbilicus by two points of chromic gut suture. The

wound was closed without drainage. Immediate operative recovery without complication.

The relief of abdominal symptoms which immediately followed the operation was not permanent. Six months later, when examined, obstipation was present in as great a degree as ever, with a good deal of distress in the region of the transverse colon and the splenic flexure. A marked degree of pylorospasm was present. Further medical treatment has been instituted. In the event of its failure to relieve an ileosigmoidostomy may be considered.

CASE XXIII.—*Marked membraniform layer covering and binding together ascending colon and first part of the transverse colon (double-barrelled shotgun arrangement); at the hepatic flexure a band-like development in the membrane constricting the gut; appendix not covered by membrane but in condition of chronic inflammation.* (Hospital No. 462.)

Woman, twenty-two years of age. Well developed, always well until six months ago, when after the birth of her first child she began to suffer from constipation with much distress, due to accumulation of flatus in the colon, particularly in the region of the cæcum. Eight weeks ago had acute appendicitis. Much vesical irritation. Upon examination she had marked tenderness over the appendix, with discomfort on pressure over the region of the hepatic flexure. Urine full of colon bacilli. X-ray-bismuth examination showed dilatation of cæcum and ascending colon; marked angulation at the hepatic flexure, with first part of transverse colon running parallel to the ascending colon for about four inches (double-barrelled shotgun arrangement).

Abdomen opened through the right rectus muscle exposed a marked membraniform layer covering the ascending colon and the cæcum and the first portion of the transverse colon, binding them together in the position previously demonstrated by the X-ray examinations. That portion of this membrane which covered the hepatic flexure was more strongly developed, forming a band markedly obstructing the lumen of the colon at that point. This band and the remaining portion of the membraniform veil were divided and reflected until the bowel was liberated and fell into its normal position. The thickened and chronically inflamed appendix was removed. Patient made an uncomplicated operative recovery. Three months after operation she reported that her bowels were moving normally from one to two times daily and that her general

condition was excellent. She has, however, had several attacks of pyloric spasm relieved by vomiting. Still has occasional frequency of urination.

CASE XXIV.—*Cæcum bound down by dense membrane which covered in the appendix; band extending from appendix to ileum, which was constricted by it.* (Hospital No. 467.)

Woman, fifty-eight years of age. Since birth of her child 35 years ago has suffered from frequent spells of so-called stomach trouble, characterized by acute cramping pain in the right upper abdomen accompanied by vomiting. These attacks would last from a few minutes to some hours. Has been icteroid, but never distinctly jaundiced. The attacks were always followed by marked tenderness in the right hypochondrium. In the intervals between these attacks she suffered from epigastric distress after meals, with frequent vomiting, much flatulent belching and bloating.

Right rectus incision exposed the cæcum bound down by a dense membraniform cover which included the appendix and bound it to the mesentery of the ileum, causing a constriction of the ileum one inch proximal from the cæcum. The constricting band binding down the appendix was divided, loosening the ileum, and the appendix itself was dissected out from its covering and removed. The pericolic membrane was divided and reflected. Passing to the hypochondriac region a greatly dilated duodenum and a chronically inflamed gall-bladder bound together by extensive adhesions were exposed. No ulcer of stomach or duodenum. Duodenum separated from gall-bladder. Gall-bladder brought up into wound, opened, and 17 gall-stones removed. Tube drainage of gall-bladder established. Balance of wound closed by layer sutures. Uncomplicated operative recovery.

CASE XXV.—*Cæcum and ascending colon covered and bound down by strong membranous bands, upper portion of which constricted hepatic flexure; appendix chronically inflamed; liver and stomach prolapsed; duodenum dilated and adherent to gall-bladder.* (Hospital No. 479.)

A woman, forty-four years of age, who always had trouble with her stomach. Two years ago had an attack of severe pain in the epigastrium, confining her to bed for some days. Thereafter she was subject to attacks of pain in the epigastrium, which would come on about two hours after eating and would be relieved by

partaking of more food. This condition became more aggravated, causing her to be confined to bed for a space of five months. During this time her constipation was very marked. When admitted to hospital she was emaciated. Her lower thorax and epigastrium were narrow. Her general nutrition, however, was still fair. The upper right rectus was quite tense, especially over the pylorus and gall-bladder. Stomach was dilated and prolapsed below the umbilicus. There was moderate tenderness in the right iliac fossa.

Operation at St. John's Hospital. The abdomen was opened by a median incision. The prolapsed stomach was as had been appreciated. In addition, the duodenum was greatly dilated, so that it was difficult to distinguish between the stomach and duodenum. Gall-bladder was entirely hidden by adhesions which bound it to the duodenum and pylorus. The liver was prolapsed. The cæcum and ascending colon were bound down by strong membranous bands, the upper portion of which constricted the hepatic flexure of the colon. The colon and cæcum were mobilized by dividing the bands that confined them. The appendix, in a state of chronic inflammation and distended by fecal concretions, was enucleated and removed. The liver was placed in its normal situation and sutured to the anterior abdominal wall in two places, according to the method of Coffey. The gall-bladder was freed from its adhesions, opened, and 14 gall-stones removed. Tube drainage was established. The gastrohepatic ligament was shortened by a purse-string suture, which was fastened to the anterior abdominal wall. The abdomen was closed with the exception of the gall-bladder drainage opening. Patient made an uncomplicated operative recovery. With the establishment of convalescence she was at once able to take food with comfort. At the present time she is able to eat practically anything. Her bowels move normally, only occasionally calling for the assistance of laxatives.

CASE XXVI.—*Cæcum and ascending colon covered by strong membranous film; appendix chronically inflamed; band from appendix to ileum angulating and fixing ileum (ileac kink); inflamed gall-bladder adherent to duodenum; old healed duodenal scar.* (Hospital No. 470.)

Man, twenty-five years of age. Patient during childhood had many attacks of abdominal distress accompanied by vomiting, culminating at seven years of age in a severe attack of what was

called acute gastritis. From the age of seven until fifteen he suffered much from pain localized in the left iliac fossa. For the last ten years has had to be extremely careful of his diet, frequently suffering from nausea and vomiting. These attacks have been more marked during the past year. Ten weeks before admission he had a very acute attack of pain in the upper abdomen, with much vomiting of greenish material. Ten days ago he had a similar attack. He suffers from constant epigastric distress. He has recently complained of many short attacks of stabbing pain in the right inguinal fossa. Examination shows him to be an emaciated man. There is marked tenderness in the epigastrium. The left upper rectus is moderately rigid. Pressure over McBurney's point elicits moderate tenderness and acute pain referred to the left inguinal fossa and to the splenic flexure of the colon. Test meal reveals achlorhydrica hæmorrhagica gastrica. Examination by X-ray-bismuth shows the stomach moderately prolapsed; defective peristalsis of the lesser curvature near the pylorus; ascending colon and first portion of the transverse colon dilated; mesocolon relaxed and transverse colon prolapsed into pelvis. The abdomen was opened through the right rectus. The cæcum was found completely covered by strong membraniform films which extended up over the ascending colon. The anterior ascending colon and half of the transverse colon were markedly whitened and thickened. The appendix, greatly infiltrated and congested, was covered in by a thickened membrane which passed below the cæcum on to the ileum, pulling the terminal ileum to the right and holding it in this position, markedly kinked. The membraniform bands were divided; the appendix enucleated and removed. Upper abdominal exploration disclosed a thickened, chronically inflamed gall-bladder adherent to the duodenum, pylorus, and lesser curvature of the stomach by strong adhesions. These adhesions were severed, allowing the various structures to resume their normal place and relations. The scar of an old healed duodenal ulcer was noted present on the anterior aspect of the gut. The gall-bladder was opened. A quantity of thick, tarry bile was evacuated, and drainage instituted. Wound closed. Uncomplicated operative recovery.

After History.—The later history of this patient has been as satisfactory as that of the previous patient (Case XXIV) has been unsatisfactory. Relief to all symptoms followed at once, and

during the months that have elapsed he has been normally free from all intra-abdominal sensations. Eats and digests completely a generous general diet. Bowels move regularly and spontaneously. Has increased in weight. Has been transformed from a suffering invalid into a normal active man.

CASE XXVII.—*Cæcum and appendix and terminal ileum enveloped in a membranous film; ileum angulated; appendix chronically inflamed.* (Hospital No. 484.)

Woman, fifty years of age. A stout woman who is still menstruating normally. Twenty years ago began to have attacks of pain in the right iliac fossa. During the years that have elapsed has had numberless attacks in various degrees of discomfort referred to that region. During the last few months has also had discomfort referred to the right hypochondrium. At times there is also gastralgia, nausea, and vomiting. Constipation is extreme. She has had pain referred to the umbilicus. Palpation reveals moderate tenderness in both the right iliac and right hypochondriac regions, and deep tenderness at the umbilicus. The abdomen was opened through a right pararectus incision. Gall-bladder showed evidences of an old cholecystitis without calculi. An old and delicate membranous film wrapped together the cæcum, ileum, and appendix, the ileum being bound to the cæcum at a sharp angle by a band of adhesions which invested the appendix. The appendix was long, thickened, and congested, and bound to the lower portion of the cæcum. It was enucleated and removed. The various portions of the pericæcal membranous film were divided. No pathological condition under the umbilicus. The gall-bladder condition was not active and it was thought not to call for any interference. Wound closed without drainage. Uncomplicated operative recovery.

CONCLUSION

As one reviews these cases, it is quite easy to accept in explanation of the presence of the extraordinary films and bands found in so many cases, investing more or less extensively the large bowel on the right side, the theory that they are persistent remnants of embryonic conditions which become contributors to disease and disability when, by the mechanical irritation of prolapsing organs tugging at a structure which

restrains it, or by an infection transmitted from within the bowel, a mild degree of proliferative inflammation is established that makes more dense and strong the constricting fibres until they interfere with peristalsis, obstruct the fecal current, and aggravate fecal stasis. It would seem as if sufficient clinical observation had now been accumulated to confirm and emphasize the teaching that right-sided pericolic membraniform veils and bands, crippling the peristaltic functions of the cæcum and ascending colon, were of frequent occurrence, and that when present they form a well-defined surgical condition which always is a menace as to the future, and in many cases has already become the cause of ill health and suffering. Whenever, therefore, the abdomen is opened for the relief of conditions involving right-sided symptoms, the operation should be so planned as to make it possible to explore for their presence and do whatever is necessary for their removal.

PERICOLIC MEMBRANES AND LANE'S KINK.

WITH REPORT OF NINE CASES.

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MEMBRANOUS films attached to the colon were long ago described by Virchow and, more recently, by Jonnesco as the "parietocolic fold" and by Treves as the "bloodless fold," but it was not until these structures were described by Lane and Jackson, and their importance as causative agents of serious pathological conditions pointed out, that any particular interest was taken in them. Even now many persons seem loath to admit that an entirely new factor has been injected into the diagnosis and treatment of many, if not a very large percentage of all cases of chronic digestive disturbances.

The structures now commonly known under the names of Jackson's membrane and Lane's kink, differ materially anatomically, and perhaps, etiologically. The former consists of a broad layer of peritoneum or peritoneum-like membrane arising from the posterolateral wall of the abdominal cavity on the right side, emerging above from beneath the liver and at times extending downward to the outer side of the ascending colon as far as the cæcum. From this origin the membrane spreads over the first part of the transverse colon, the hepatic flexure and the ascending colon, and blends with the peritoneum of these structures near the attachment of the mesentery. The extent of the attachments of this membrane is very variable. It is frequently limited to the region of the hepatic flexure.

The membrane causing Lane's kink is a narrow band extending from the peritoneum of the right iliac region to a point on the terminal ileum, usually within a few inches of the ileocæcal valve. This band is attached to the under surface of the mesentery and to the wall of the ileum as far as its anti-

mesenteric border. Not infrequently, the appendix is adherent to the under surface of the mesentery and from its point of attachment numerous thread-like bands extend to the wall of the ileum. In such cases there may be no sign of any inflammation of the appendix, past or present.

Jackson's membrane can usually be divided and separated from the underlying colon practically without bleeding and without leaving an area bare of peritoneum. This can sometimes be done with Lane's band, but as a rule, the latter membrane seems incorporated with the peritoneum of the under surface of the mesentery and its division leaves a raw surface which has to be covered in.

The most common effects of these membranes and bands is to produce a kinking or angulation at two points, namely, at the hepatic flexure and in the last few inches of the ileum. Such angulation causes a partial obstruction, intestinal stasis, and occasional spasmodic efforts on the part of the intestine to overcome the obstruction.

Three theories have been advanced as to the etiology of the membranes under consideration: First, that they are evolutionary in origin; second, that they are congenital or developmental, and third, that they are inflammatory.

The first theory is that of Lane and may be briefly stated as follows: In the assumption by man of the erect position, there is a tendency of the intestine to gravitate downward, this tendency being especially marked at the flexures and at the cæcum. In the process of evolution, nature forms bands and membranes to support these points—there is a “crystallization of the lines of strain.”

The second theory advanced by Mayo, Cheever and others attributes the formation of the membranes to certain abnormalities in the rotation and descent of the cæcum. Mayo suggests that the cæcum may insinuate itself beneath a fold of peritoneum and, in carrying this downward, during its descent produces the membrane. Cheever believes that the membrane is formed by the cæcum and colon rotating to the left instead of to the right, thus drawing a peritoneal layer over them.

The third theory, that of inflammation, is advanced by Pilcher, Gerster and others. According to this theory the membrane is the result of irritation caused by the "oft-repeated, but mild," inflammation arising from within the bowel and transmitted through its walls.

Lane, Gray, Fagge and others, in England, and Bainbridge, in this country, describe membranes attached to the splenic flexure and sigmoid in addition to those attached to the hepatic flexure, ascending colon and terminal ileum. The majority of American writers, notably Jackson, Mayo, Pilcher, Binnie and Frazier, describe the membrane as being confined to the right side of the abdomen. The latter view coincides with the theory of the congenital or developmental origin of the membranes, and agrees with the conditions observed in the cases quoted below. In Germany, much importance has been attached to excessive mobility of the cæcum—the "cæcum mobile" of Wilms. American writers seem to agree that this excessive mobility is probably due to the dragging of a dilated and overloaded cæcum, itself the result of an obstruction by membrane at the hepatic flexure. It seems unquestionably true that in many cases the cæcum is unduly movable and prolapsed.

Many writers seem to confuse the condition we have attempted to describe with a general enteroptosis or with ptosis of the stomach and transverse colon, the gastrocoloptosis of Rovsing, the midline ptosis of Coffey. That an enteroptosis will cause attacks of abdominal pain with vomiting and will in time result in a true picture of auto-intoxication, there is no doubt, but in such cases the limitation of the pain and tenderness to the right side of the abdomen is entirely lacking. It is this limitation of pain and tenderness with the other symptoms enumerated below, that makes the diagnosis of obstruction by these right-sided membranes, whether we call them by the name of Lane or of Jackson.

What then are the symptoms that will lead us to a diagnosis of Jackson's membrane or Lane's kink? Briefly, they are symptoms of obstruction and of stasis, the latter evidenced by the symptoms of intestinal auto-intoxication.

The symptom most frequently complained of is *pain*. The pain may be acute or it may be chronic with exacerbations, and it is *almost always referred to the right side of the abdomen*. The pain is usually most marked in the region of the appendix (terminal ileum) or at the hepatic flexure. There may be acute attacks of abdominal pain, with or without vomiting, but in such cases the pain is never referred to the epigastrium or diffused over the entire abdomen as is the case with appendicitis. It is in no case a general pain, becoming local, but is commonly referred to some definite locality, in the right side of the abdomen, most commonly the right iliac region.

Less frequently the pain is referred to the region of the hepatic flexure, but in such cases has none of the characteristics of gall-bladder pain with which it might be confused.

In some cases the pain is a chronic soreness with feeling of distention, and in many such cases pressure over the cæcum and ascending colon seems to give relief. In a few cases pain is not localized.

Tenderness is even more strictly localized than the pain. Very commonly this tenderness is most marked at the usual site of appendix tenderness, but perhaps a little lower down. In other cases the maximum tenderness is in the region of the hepatic flexure, that is, below the ribs on the right side but further out than the common site of gall-bladder tenderness.

In many cases there is a feeling of distention by gas. One patient complained of even the weight of his undershirt. These attacks of pain and tenderness are not accompanied by a rise of temperature or an increase in the number of the leucocytes, which further differentiates the condition from an acute inflammation.

Constipation is a marked feature of practically all these cases. It may be moderate or it may be extreme. It may be the chief complaint, or it may not have especially attracted the patient's attention.

Auto-intoxication is a prominent feature of a majority of the cases. In addition to abdominal pain, tenderness, and constipation, these patients complain of backache, headache, lassi-

tude and a general sense of ill-being. The complexion is sallow, muddy and, occasionally, spotted. There are rings beneath the eyes, and the hands are cold and clammy. The appetite may be disturbed, and the patient complains that whatever he does is only accomplished with the greatest effort. Such patients are evidently carrying a heavy load, and they finally drift into a neurasthenic state with an unlimited number of complaints of pain and of aches, of lassitude and of malaise.

In some cases the symptoms of auto-intoxication entirely overshadow the symptoms of pain and tenderness and constipation and it is only by careful questioning, and examination that the latter points are brought out.

In many cases bismuth radiographs are of great assistance in diagnosis. This is especially true of angulation at the hepatic flexure. Obstructions at the terminal ileum are far more difficult to radiograph, but fortunately in this latter group the clinical symptoms may be relied upon for diagnosis.

The treatment of these cases is essentially surgical. A mechanical fault requires a mechanical remedy. By diet, massage, and purgatives, of which latter the "Russian mineral oil" is the best, the symptoms in some cases may be held in abeyance. The surgical treatment consists of a free abdominal incision through the right rectus muscle, a careful exploration of the regions of the terminal ileum and of the hepatic flexure, division of all restricting bands and membranes and a covering in of all raw surfaces when such result. This may usually be easily accomplished by dividing the restricting membrane transversely and uniting the margin of the denuded area longitudinally. In some cases division of the membrane leaves no denuded area, consequently plastic approximation of peritoneum is unnecessary.

In those cases in which the cæcum is dilated and unduly movable, a plication of the walls of the cæcum at the "caput coli" may be done, and the movable cæcum may be fastened to the posterolateral wall of the abdomen. We have accomplished this in two cases by uniting the external longitudinal band of the cæcum to the lateral abdominal wall by two or three interrupted sutures of Pagenstecher.

There follow the histories of nine cases admitted to the United States Naval Hospital, New York, N. Y., during the past eight months upon which the foregoing remarks have been based:

CASE I.—G. M., private, U. S. Marine Corps, aged twenty-two years.

The following entries are from the health record of the patient:

"U. S. S. Wyoming—December 6, 1912. Note: During the last two months G. M., private, U. S. Marine Corps, has been to the sick-bay frequently, complaining of indefinite and vague symptoms. It is believed he is malingering. Warned."

"U. S. Wyoming—December 28, 1912—*Constipation*. This man is chronically constipated, bowels not moving without artificial help. He states that he has gone as long as seven days without a movement. He is a chronic sick-bay caller, complains of constant headache, pains in abdomen, swelling of feet, muscle cramps, etc., is not a husky individual. Is listless, apathetic, in fact, a diagnosis of "constitutional inferiority" might cover the case. Transferred to the U. S. Naval Hospital, Brooklyn, N. Y., for further disposition."

Admitted December 28, 1912, with the diagnosis of *constipation*.

History.—Never seriously ill before present trouble. Has always been somewhat constipated, bowels going two or three days without moving.

Present trouble began about four months before admission with sudden attack of dizziness, headache, abdominal pain and nausea. Was unable to walk to Barracks. Since this time has had headache, pain in abdomen, dizziness and at times, cold sweats. Bowels have not moved since the onset of this somewhat acute condition without a purgative, and then only once every three or four days. On one occasion seven days elapsed without a movement. Feels sick and weak almost all the time. Feels somewhat better after exercise.

On admission a sallow, unhealthy-looking individual who complains of headache and constipation.

Abdominal palpation shows quite marked tenderness in the region of the hepatic flexure.

Bismuth radiographs six, eight, ten, twelve and twenty-four

hours after taking four ounces of bismuth oxychloride in milk shows marked obstruction at hepatic flexure. The radiograph is shown in Fig. 1.

Operation (March 18, 1913).—Ether anæsthesia. Right rectus incision eight inches in length. Ascending colon dilated, transverse colon collapsed. Just beyond the hepatic flexure a pericolic membrane stretches from the surface of the bowel near the attachment of its mesentery over its anterior and upper surface, losing itself in the peritoneum of the posterior abdominal wall beneath the liver near the attachment of the mesocolon.

This membrane is freely divided transversely. When division is completed gas is seen to pass into the collapsed transverse colon. The constriction is evidently relieved. A membrane binding together the last two or three inches of the ascending and the beginning of the transverse colon is likewise divided. Appendix removed. No Lane's bands or kinks, no obstruction at splenic flexure or sigmoid. Abdomen closed in layers.

March 27. Recovery uneventful save for signs of moderate consolidation at right base causing rise of temperature to 102.8° on the third day, which almost immediately subsided to normal.

April 15. Patient weighs six pounds more than before operation and bowels are moving every day.

April 28. Discharged to duty, well. He feels and looks like a different man.

This case has been traced for five months and patient has remained well.

CASE II.—G. A. L., chief carpenter, U. S. Navy, aged thirty-seven years. Admitted March 27, 1913, with diagnosis of neurasthenia.

Trouble began about eight months before admission with malaise, constipation and vague abdominal pain limited mainly to right side of abdomen. The abdominal pain increased in severity and became more strictly localized. There were never any acute attacks referred to the epigastric region. Constipation became more marked. Headache soon appeared with a feeling of fulness in the head, and marked lassitude.

With these symptoms he was operated upon three months after the beginning of his trouble (October, 1912). The appendix was removed through a low right rectus incision, and the patient was informed that there was a "Jackson's membrane." He im-

FIG. 1.



Case 1. Radiograph 12 hours after bismuth meal, showing marked obstruction of the hepatic flexure. At operation a Jackson's membrane was divided, which stretched over the flexure and caused the obstruction.

FIG. 2.



Case II. Radiograph taken 48 hours after bismuth meal, showing acute angulation at the hepatic flexure and marked stasis. Note that the first part of the transverse colon descends parallel with the ascending colon, almost to the ileocaecal valve. Note that the tail of the bismuth column has not passed the hepatic flexure at the expiration of 48 hours.

FIG 3



Case IV. Radiograph 24 hours after bismuth meal, showing obstruction just beyond the hepatic flexure. The entire mass of bismuth is in the cæcum and ascending colon.

FIG. 4.



Case VI. Radiograph 36 hours after bismuth meal showing angulation at hepatic flexure and marked stasis.

FIG. 5.



Case IX. Radiograph 38 hours after bismuth meal. Note sharp angulation in proximal third of transverse colon. At operation a Jackson's membrane was found which held together the descending and ascending limbs of this angulation. Upon division of this membrane the intestine unfolded as if released from a bag.



proved for a month, or more, following the operation and then the symptoms became more marked.

On admission, patient is a well-nourished, well-developed man of thirty-seven years. Has a distinct sallowness of skin and circles beneath the eyes.

The patient complains of headache, of abdominal pain and also of pains and aches in almost every part of the body. Since his operation, constipation has not improved.

Examination shows tenderness over the cæcum and ascending colon, especially marked in region of hepatic flexure. A bismuth radiograph of the intestines shows a marked angulation at the hepatic flexure, the first portion of the transverse colon descending parallel with the ascending colon to the neighborhood of the ileocæcal valve. Mass of bismuth still present in the cæcum and ascending colon after forty-eight hours. The X-ray photograph is shown in Fig. 2.

Patient was put upon mineral oil (Russian paraffin) but did not improve. The headaches and the other pains and aches continued. He complained of distention by gas. Even the weight of his undershirt seemed a burden. A right-sided tenderness persisted, at times being marked over the entire cæcum and ascending colon, and especially at the hepatic flexure. Frequently a dilated cæcum could be easily palpated.

The patient was discharged to sick leave May 28, 1913, and returned June 27, 1913, somewhat improved as to his mental condition, *i.e.*, the symptoms of neurasthenia were not so marked.

Operation was refused, and the patient was discharged July 16, 1913, in about the same condition as when he was primarily admitted.

It is evident in this case that a sharp angulation at the hepatic flexure brought about stasis in the cæcum and ascending colon and that this condition led directly to the various neurasthenia symptoms above noted. The region of the hepatic flexure could not have been explored through the small and low rectus incision.

CASE III.—W. B. J., landman for electrician, U. S. Navy. Admitted May 14, 1913, with the diagnosis of acute appendicitis. Gives history of constipation for seven months; of headache and backache for six months. Five months ago pain was first noticed on the right side of abdomen and has continued to date. Has never vomited. Feels dull and lazy and tires easily.

Examination.—Shows distinct tenderness over ascending colon, most marked over McBurney's point. There is also tenderness over sigmoid but not so marked. X-ray examination shows stasis, bismuth in ascending colon after twenty-four hours.

Operation (June 9).—Ether anæsthesia. Right rectus incision. Appendix chronically inflamed and adherent to under surface of mesentery of ileum with numerous fine bands running from the tip of appendix to a point on lateral wall of ileum about two inches from its termination. This condition caused acute "kinking" at this point. The bands were divided. Appendix removed. Denuded surface covered by drawing together the peritoneum in a direction at right angles to the bowel. This denuded area was mainly upon under surface of mesentery.

June 20. Primary union. Recovery uneventful save for considerable post-operative vomiting for first two days.

July 3. Bowels move daily. Pain entirely relieved. Discharged July 10, 1913, bowels move daily without purgatives. Headache, backache and abdominal pains have entirely disappeared.

CASE IV.—L. O. S., chief pharmacist, U. S. Navy. Admitted May 26, 1913, with intestinal auto-intoxication.

History.—For the past year has had frequent and severe headache. During this time there has been marked constipation with occasional mucous diarrhœa. Has found it necessary to take purgatives once or twice a week on the average. Chief complaint headache, also complains of malaise and lassitude. On admission a fairly well nourished man of thirty-eight years, complexion clear. Examination shows moderate but well-marked right-sided abdominal tenderness, most marked in the region of the hepatic flexure. No history of acute attacks of abdominal pain.

A radiograph of the intestines taken twenty-four hours after the administration of four ounces of bismuth oxychloride in a pint of buttermilk shows the cæcum and ascending colon loaded with bismuth. Just distal to the hepatic flexure there is evidently a marked obstruction as the bismuth column terminates abruptly at this point (see Fig. 3).

A second radiograph taken forty-eight hours after bismuth meal shows that peristalsis has overcome the obstruction and that practically the entire amount of bismuth is in the transverse colon.

In this case there is evident obstruction and very marked

stasis, as the tail of the bismuth column has not passed the hepatic flexure at the end of forty-eight hours.

CASE V.—A. L. M., seaman, U. S. Navy. Admitted January 4, 1913, with deformity of nose. Deformity corrected March 11, 1913.

Readmitted June 11, 1913, with intestinal auto-intoxication. History of constipation, abdominal pain, slight malaise, lassitude and frontal headache for one year and a half. The pain was always referred to the right side of abdomen. Is able to do his work but does it with great effort.

Examination.—Well-developed, fairly well-nourished man of twenty-four years. Marked tenderness over McBurney's point and slight tenderness over entire ascending colon.

Operation (June 16, 1913).—Ether anæsthesia. Right rectus incision. Appendix chronically inflamed, removed. Cæcum extremely movable, can be carried across midline. Extending from the hepatic flexure to the parietal peritoneum in a direction upward and outward there is a well-marked Jackson's membrane producing a definite angulation at this point. This membrane is divided transversely and the denuded area covered by bringing together the peritoneum in the direction of the long axis of the membrane with a continuous Pagenstecher. The mobile cæcum is fastened to the posterolateral wall of the abdomen by two sutures of the same material.

June 24, 1913. Recovery uneventful save for moderate greenish vomiting for first two days.

June 30, 1913. Recovery uninterrupted.

July 3, 1913. Abdominal pain entirely relieved. Feels better in every way.

July 25, 1913. Discharged to duty. Feels entirely well. Bowels moving regularly.

CASE VI.—R. H. J., past assistant paymaster, U. S. Navy, age thirty-three years.

The following entries are from the health record of this patient:

"U. S. Naval Hospital, Washington, D. C., March 21, 1913. Admitted with history of severe abdominal pain followed by gaseous distention about March 5. Was very much prostrated at the time. Attack passed away with passage of flatus. Last night was seized with diarrhoea and passed a small amount of clotted blood, no tenesmus."

Admitted to the U. S. Naval Hospital, New York, June 29, 1913. Gives history of prolonged tropical duty and of mental strain and worry. About sixteen months ago had an attack characterized by abdominal pain, vomiting, dizziness and looseness of bowels. Since this time has had five or six similar attacks. During one of these attacks blood and mucus were passed. Bowels always regular. Complains of malaise, of lassitude and abdominal discomfort and occasional abdominal pain. This pain is not localized but there is marked local tenderness below the ribs at the hepatic flexure. Is markedly neurasthenic; dwells much upon his troubles, mental and physical. Is well nourished but is decidedly sallow; complexion muddy and there are dark rings under the eyes.

X-ray examination of intestines after bismuth meal shows very marked stasis. The bismuth begins to pass the hepatic flexure only after thirty-six hours. At this period the ascending colon is distended with bismuth and there is marked angulation at the hepatic flexure (see Fig. 4). The patient's history and physical condition with the X-ray findings making an almost positive diagnosis of chronic intestinal intoxication from stasis which is probably caused by Jackson's membrane at the hepatic flexure.

Discharged to duty June 30, 1913. Relief of condition by operation suggested but declined. This patient's condition has improved upon a vegetable diet and purgatives.

CASE VII.—J. W. E., chief gunner's mate, U. S. Navy. Admitted July 19, 1913.

A well-nourished man of thirty years. Has been chronically constipated for past three or four years. About one year ago had sharp attack of abdominal pain, confined to right iliac region, lasting only for a minute or two, no nausea or vomiting. Felt dizzy. About six months ago had a second attack, similar to the first, but more severe, lasting two or three minutes, no nausea or vomiting.

Third attack, three weeks ago, lasting for three days with remissions. During this time vomited frequently, whenever food was taken. Pain confined to right iliac region.

Examination.—Shows tenderness quite marked and strictly localized to a small area below and internal to McBurney's point.

Operation (August 20, 1913).—Ether. Right rectus incision. Two typical Lane's kinks were found, one about three inches and the second six inches from the ileocaecal valve. The band produc-

ing the kink nearest the valve, could be entirely separated from the underlying mesentery. This band was simply divided and its division caused almost no bleeding and left no raw surface.

Division of the second band left a denuded surface which was covered by drawing peritoneum together in direction perpendicular to the gut.

The appendix, which was quite normal and lay behind and to outer side of cæcum and reached to the liver, was removed and stump inverted. Uneventful recovery. Feels better now (September 20) in every way. Bowels now move regularly, twice a day, without purgatives.

It is to be noticed in this case that the point of tenderness was over the site of the "kinks" and not over the site of the appendix.

CASE VIII.—U. S. P., seaman, U. S. Navy. Admitted August 6, 1913.

History.—Severe furunculosis of back for past seven months, frequent headaches for the past six months; constipation for the past seven months. Six months ago severe attack of pain in right iliac region, lasted thirty minutes, nausea but no vomiting.

Three months ago, second attack. Three weeks ago, third attack. One day ago, fourth attack. First attack most severe. In all attacks pain is limited to the right iliac region. There has been no epigastric or general abdominal pain at any time.

Examination.—A well-developed, well-nourished boy of twenty-one years, whose back is covered with a great number of furuncles for which he has been continuously under treatment since February 2, 1913.

Abdominal palpation shows tenderness over entire right side of abdomen most marked near McBurney's point. The point of maximum tenderness is rather strictly localized.

Operation (September 3, 1913).—Ether; right rectus incision. A long slender appendix is found which is adherent to the under surface of the mesentery of the ileum at a point about one inch from its tip. From this point numerous fine bands run to the lateral wall of the ileum at a point about three inches from the ileocæcal valve. When the ileum is lifted up these bands produce a marked kinking at their point of attachment. The appendix is absolutely normal. Appendix removed, stump inverted. The bands are divided and the raw surface is covered by bringing to-

gether its margins with a continuous Pagenstecher in a direction perpendicular to the gut.

September 30, 1913. Recovery was uneventful. Bowels now move daily.

CASE IX.—O. F. B., hospital apprentice, first class, U. S. Navy, age twenty-two years. Admitted September 16, 1913.

History.—Until the onset of present trouble was an unusually healthy and active man.

For the past two years there has been marked constipation with malaise and lassitude and frequent headaches. During this period the bowels have moved on an average of but once in three days. The patient has felt "dull and heavy" all the time.

About two months ago he first experienced abdominal pain, dull in character and confined almost entirely to the right side. The pain is most marked in the region of the hepatic flexure, but exists to a much less degree in the region of the appendix, and in the left iliac region. The appetite has been excellent and there is no discomfort after eating. On several occasions the patient has noticed a distinct distention of the right side of his abdomen.

On examination the patient is fairly well nourished but extremely sallow. There is marked tenderness on palpation beneath the ribs on the right side and to a much less degree at the site of the appendix. The dilated cæcum and ascending colon can be easily felt. Radiograph, thirty-eight hours after bismuth meal, shows marked angulation at the hepatic flexure and very marked stasis (see Fig. 5).

Operation (September 17, 1913).—Ether; right rectus incision. Appendix normal, removed. No Lane's kink.

Covering the first six inches of the transverse colon there is a Jackson's membrane, descending on the upper surface of the mesocolon from beneath the liver. This membrane contains numerous fine blood-vessels and is attached to the middle of the longitudinal bands of the transverse colon. On division of the membrane, throughout its entire length, the intestine unfolds as if released from a bag. Precisely this condition has been described by Jackson. Several bleeding points are caught with fine Pagenstecher. Division of the membrane leaves no raw surface. Abdomen closed in layers.

September 30, 1913. Uneventful recovery from operation. Calomel was given on the third day, post-operative, since which time the bowels have moved daily without purgatives.

PERICOLITIS SINISTRA.

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AND

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REPORTS of cases of membranous pericolicitis, involving the right half of the colon, have multiplied since Jackson made his first report, and the condition is now looked upon as an established clinical process of rather frequent occurrence. The splenic flexure and descending colon may be embraced in a similar manner by fettering bands or sheets of anomalous peritoneum. Virchow, Gerster, Cannon, Holzknecht and Bloch consider the splenic flexure a site of predilection for the process.

The patient whose case is here described was a man, aged sixty-four. The family and personal histories were negative as to any data pertinent to the condition for which he presented himself for examination. For about a year he had suffered extreme anorexia, with consequent loss of weight. Aside from a general sense of ill-defined discomfort over the abdomen and rather obstinate constipation, there were no other subjective symptoms. Examination of the abdomen revealed an irregular resistance occupying the site of the colonic splenic flexure. At X-ray examination the patient, with abdomen bared, was placed upon his back on a fluoroscopic table in the dark room with the X-ray tube below and the fluoroscopic screen above the table. An enema consisting of 90 grammes of barium sulphate, 100 grammes of bolus alba, and 1500 c.c. of water was slowly injected into the rectum by means of a bulb syringe, and while carried up through the bowel was observed fluoroscopically. The rectum, sigmoid and lower part of the descending colon were seen to fill quickly, but when the barium column reached the upper part of the descending colon it was arrested. It then slowly began to balloon out the bowel until it was dilated to the size of a large fist. After a delay of six or eight minutes the enema was seen to move on slowly into

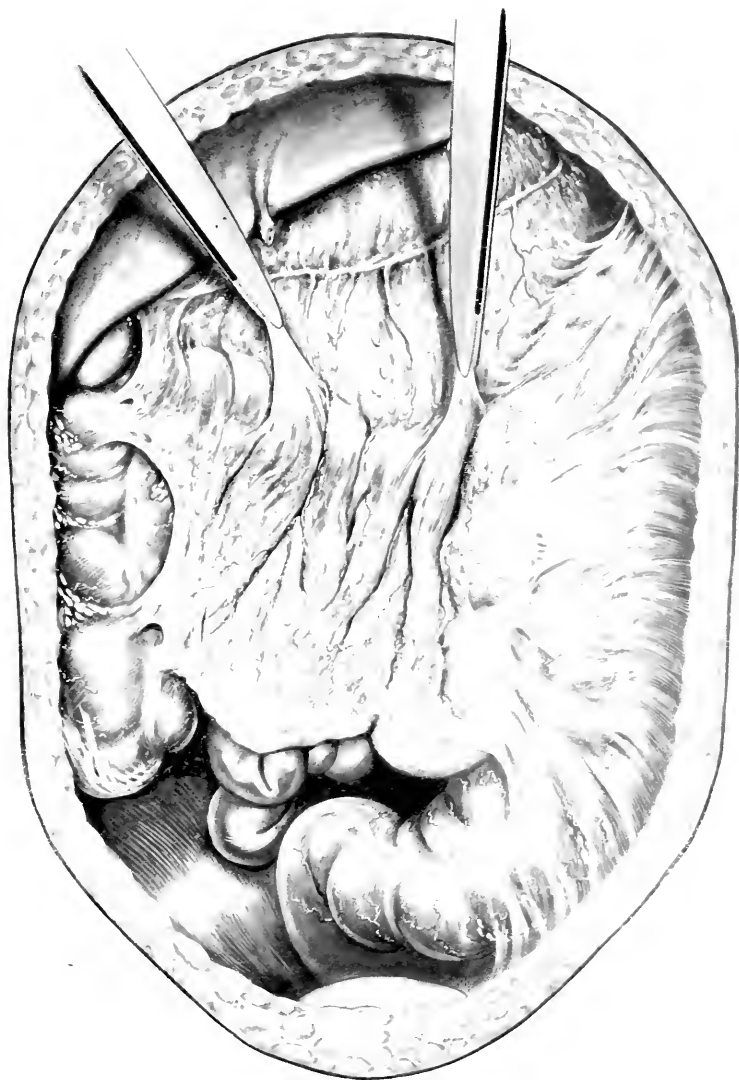
the transverse colon, which it filled about half its length across the abdomen, where it was finally arrested, and repeated observations during a period of an hour failed to show it filling the remainder of the colon. After an interval of ten days a confirmatory examination was made and 2000 c.c. of enema, instead of 1500 c.c., was used. At this time the same observations were made. This enema was again delayed at the splenic flexure, widely dilating the descending colon below, and again after six or eight minutes the enema was seen slowly passing through the splenic flexure to fill the transverse completely this time, and then the ascending colon and cæcum. A plate was then taken which pictured the distended descending colon with a blurred outline at the splenic flexure.

The patient would not permit an examination with the bismuth meal given by the stomach to detect the degree of obstruction when the colon contents approached the splenic flexure the natural way.

The X-ray diagnosis was partial obstruction at the splenic flexure. From the other signs and symptoms it was inferred that the obstruction was probably malignant. At operation a condition of *extensive pericolicitis involving the splenic flexure and descending colon* was found, as is fairly well illustrated in Fig. 1. The left lateral margin of the great omentum was attached to the serosa of the splenic flexure and descending colon by thin sheets and bands of peritoneum, which apparently had been formed by fusion of the anterior and posterior peritoneal laminæ of the omentum. These fused peritoneal layers of the great omentum passed in front of the descending colon and blended in with the left lateral abdominal serosa.¹ The whole of the descending colon was thus invested almost to the beginning of the rectum. It was, however, not possible to draw up a single sheet or sleeve of peritoneum as has been observed upon the right side. The picture was not unlike that of ordinary membranous adhesions which might attend or be consequent upon peritonitis, although there was, in this case, no history whatever of peritonitis.

¹The phrenocolic ligament of Toldt is derived from the great omentum. It passes over the splenic flexure to adhere to the parietal peritoneum opposite the tips of the tenth and twelfth costal arches.—D. G. Reid.

FIG. 1.



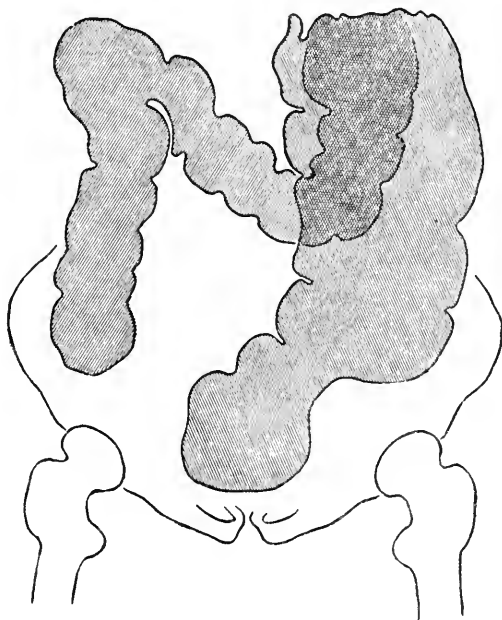
Extensive left-sided pericolicitis with angulation and partial obstruction at the splenic flexure, as described by Gray and Anderson.

FIG. 3.



Cases in which the great omentum forms a covering to the underlying colon have been described by L. S. Pilcher and J. N. Jackson, and have been observed in the foetus by one of the writers (J. R. Eastman, *Surgery, Gynecology and Obstetrics*, May, 1913) and Douglas G. Reid, of the University of Cambridge (*Journal of Anatomy and Physiology*, October, 1912). In Pilcher's case the result of the presence

FIG. 2.



Descending colon filled with enema of barium sulphate, arrested at splenic kink.

of peritoneal sheets and bands thus formed was to sharply angulate the colon at the hepatic flexure and to bring parallel to each other the ascending colon and the first part of the transverse colon, causing them to lie side by side like the two barrels of a double-barrelled shotgun (*ANNALS OF SURGERY*, January, 1912).

In our case of pericolicitis sinistra a somewhat similar state of affairs existed upon the opposite side, as indicated by Figs. 1 and 2. However, that the last part of the transverse colon

and the beginning of the descending colon should be held together in the double-barrelled relation is not remarkable in view of the circumstance that the splenic angle is, under normal conditions, an acute angle as shown in Fig. 3, and not one of 90 degrees as might carelessly be assumed. If there be ptosis of the transverse colon the angulation at the so-called splenic flexure may be quite sharp, for the phrenocolic ligament of Toldt is so firm as to preclude the splenic flexure from participation in the ptosis. If the phrenocolic ligament be short and tense, splenic kink as described by Gray and Anderson (*The University Press, Aberdeen, Scotland, 1912*), sometimes called Payr's disease, may ensue. In our case the splenic angle was sharply constricted and fettered by pericolic membraniform adhesions and the transverse and descending limbs of the colon were held up sharply angulated by the phrenocolic ligament. It was, in all probability, this sharp angulation of the colon and the fettering by pericolic bands which retarded the flow of the barium sulphate through this colonic segment, and gave rise to the ballooning of the bowel previous to the slow passage of the barium column through the constricted splenic angle. It was noted also that there were, in addition to the left-sided pericolitis, numerous adhesions between the left margin of the omentum and the ascending colon, and that the vermiform appendix was buried beneath a pericolic membrane.

Since in the case here reported the membranous adhesions were, for the most part, not in the neighborhood of the caput coli or ascending colon, their origin cannot be ascribed to persisting fetal folds of Jonnesco and Juvara, or Treves or Douglas Reid. However, it is not altogether illogical to suspect such membranous adhesions, even upon the left side, of dating from the fetal period of life in view of the common appearance of such adhesions in the foetus. In Fig. 4 is shown the extensive area of peritoneal adhesion between the stomach and transverse colon, as observed by Douglas Reid in the foetus. That extensive pericolic membranes of the left side are consequent upon adhesion formation before cæcal

rotation, descent, and torsion has taken place can only be assumed. However, the general distribution of peritoneal adhesions in the fœtus suggests the possibility of adhesions between the mural serosa and the peritoneum of the rotating colon having part in the causation of membranous pericolicitis of the left side as well as of the right.

It is probable that an indeterminate proportion of pericolic membranes are of purely postnatal origin. Interesting in this connection is an observation of Bevan, who removed the

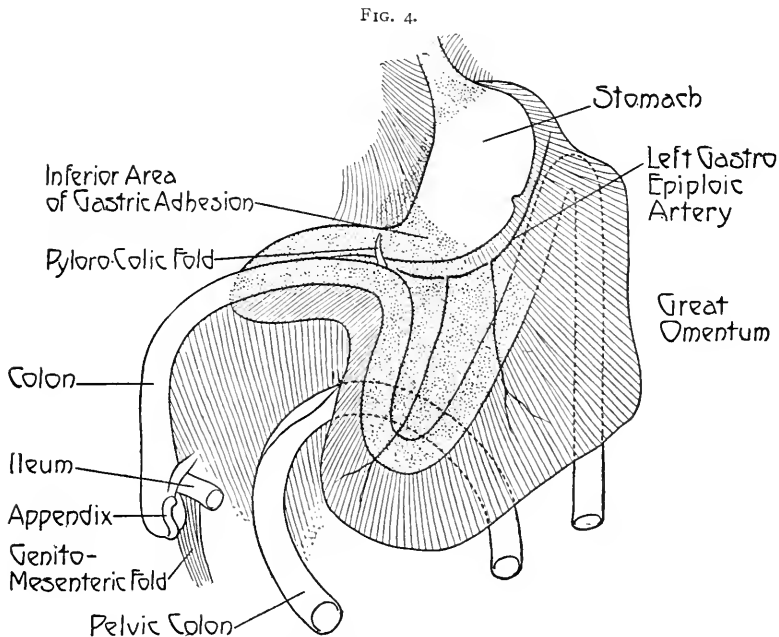


Diagram after Douglas Reid, showing area of peritoneal adhesion between the stomach and transverse colon in the fœtus.

vermiform appendix in a case showing no sign of pericolic membranes. A year later he re-operated, finding a well-developed membranous pericolicitis.

The discovery of pericolic membranes in the fœtus does not explain their origin. The fact of their presence in the fœtus and evidence indicating that such anomalous membranes are the result of peritoneal adhesion, for example between

the rotating colon and the mural serosa, still leave in doubt the nature of the process which actually causes the two serous surfaces to adhere, and, until otherwise proven, it seems fair to suspect, in the case of the fœtus as well as of the adult, such well-known causes of adhesion as infection, mild or severe, and mechanical or other irritation.

The rather frequent occurrence of membraniform adhesions in dogs² emphasizes the likelihood of continued colonic stasis having an important part in their causation, as contended by Gerster, and supplies evidence to the effect that the upright posture is not an essential factor of their etiology.

It is of some interest to note that the extensive attachment of the left margin of the great omentum to the lateral mural serosa, as observed in our case, represents simply an extreme exaggeration of the adhesion which forms the apparently normal ligament of Toldt.

² Eisendrath, Journal A. M. A., August 30, 1913.

CANCER AND PRECANCEROUS CONDITIONS.*

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AT no time in the world's history has that ancient, pitiless and ubiquitous, hence most dreaded enemy of mankind, cancer, been studied so generally, so systematically, so unceasingly as during the recent past. State and philanthropist the wide world over have entered upon its pursuit with unlimited energy, talent and means, and if the quest has not been entirely fruitful, no unbiased critic can say that it has been fruitless. Much has been revealed concerning the history, pathology, and treatment of carcinoma, even though its direct or exciting cause remains the great unsolved problem of the day, as it has been of the ages.

Unfortunately too, and it should be candidly admitted, but little additional information has been given to the clinician which might enable him to detect unerringly, in its early stages, a foe so stealthy that mastery over its victim is oftentimes complete before its recognition, since a disease strictly local, and therefore curable primarily, has become, through metastases, a general, constitutional and incurable one. Not only is this true of deep-seated and internal carcinomata, as one might reasonably expect, but almost is true of superficial or external lesions, susceptible of either palpation, sight, or both.

Important, superlatively needful, as it is to ascertain, if possible, the cause of cancer, are we not, in its search, neglecting valuable means already at hand, facts proven to the hilt, which if employed rightfully and in time would undoubtedly save thousands where hundreds are now being saved?

Will it not startle some of you, experienced surgeons that

* Annual Oration of the Academy of Surgery of Philadelphia, delivered October 6, 1913.

you are, to know that 90 per cent.¹ of the cases of cancer of the cervix are inoperable when first seen by a surgeon; that 90 per cent.² of gastric carcinomata are inoperable; the same with 29 per cent.³ of those in the breast, and, on account of its more rapid course, a larger number of cancers of the tongue and mouth? Mark you, I do not mean only that so many cases are unfavorable or fairly late ones, but are actually inoperable; in other words, without a reasonable chance of removing the disease. What does this mean to us as citizens of the United States where there are upward of 40,000⁴ deaths from cancer annually, and where, as in Great Britain, perhaps, one man in eleven and one woman in eight⁵ dies of the disease?

Why it means that 15,000 at the least die of cancer of the stomach. How few are saved one is, for the cause of so heavily handicapped surgery, ashamed to state. In not a great many more is the slightest attempt made to save life, the most done being a palliative gastro-enterostomy. How many here have saved such a patient? Your essayist candidly admits that he has not rescued a single one, and does not expect to, unless it be by accident or fortuitous circumstance, until an entirely different order of things obtains. So long as gastric cancer is looked upon as a medical affection and treated as such until starvation threatens its host, when, only as a *dernier ressort*, a surgeon is called in to assume the responsibility for a death which is no longer doubtful, but only a matter of time, just so long, I maintain, will surgery be impotent. Naturally the physician, nearly always through pride of opinion, waits until he can by symptoms, signs, test meals, skiagrams, etc., etc., make a positive diagnosis. When this can be done the case is no longer operable. We, as surgeons, know it, and yet keep on doing palliative operations, which may or may not palliate, but which certainly, at the very best, are only of temporary

¹ Childe.

² Munroe and Bottomley.

³ Halsted.

⁴ Chas. H. Mayo.

⁵ Roger Williams.

benefit, while their deterrent effect upon others with operable conditions is far-reaching and permanent. To them their friend or acquaintance died, not from cancer, but an operation; hence they themselves will have none of it.

When it is realized that the situation is about as bad in uterine cancer, not much better in cancer of the mouth and tongue, and only somewhat better in mammary carcinoma, then I say that it is time for surgeons to teach, write and act collectively and in unison. Operations upon advanced cases of carcinoma should neither be practised nor sanctioned, unless for the best of reasons. We have all, through a mistaken sense of duty to the patient in hand, performed useless, or worse, harmful operations, and in every such instance have increased the croakings of the pessimist, in and out of the profession, and unconsciously made it more difficult to rescue the operative surgery of malignant disease from that obloquy which now rightfully rests upon it as a whole. The results of individual operators, in particular regions to which they have given special attention, have done something, it is true, to inspire hope, if not to create a justifiable optimism concerning a disease that, not so very long ago, was looked upon, no matter where situated and with or without operation, as hopeless. But, as intimated above, and the argument is frequently used and pressed home, has not the patient a right to demand the slim chance of cure that has been held out to him, even when the surgeon of experience feels assured there is no chance at all? I unhesitatingly answer in the negative and for the following reasons, though of course I wish it clearly understood that by advanced I mean inoperable and not border-line or doubtful cases. By inoperable, to repeat, we mean a condition no longer local, but general, and one which cannot, therefore, with reasonable certainty be extirpated on account of metastases to adjacent or distant tissues or organs. In the first place your essayist does not hesitate to affirm that he has little faith in the spontaneous recession of a carcinomatous growth after incomplete removal, as he has seen no such result in any of the many operations he has himself done, assisted in, or seen others do, after a

fairly large experience of the disease in more than thirty years of practice. Nearly, if not all, of such instances can be more rationally explained by a modern and enlightened pathology. A majority of them were abdominal growths and, moreover, were sarcomata. Sarcoma is a less stable growth than carcinoma and one can more readily believe, even though he does not comprehend how and why, that such neoplasms may, in some mysterious manner, undergo retrogression after a rapid, active, even luxuriant growth. I have never known spontaneous recession of a sarcoma to occur, but have seen it take place after free use of X-rays and Coley's toxins in a few instances. In most of these, again, the mass underwent retrograde changes only temporarily, later on to resume an unwonted activity and destroy its victim. But as diminution often, and seemingly complete disappearance occasionally, has occurred coincident with the use of various non-operative measures, I am willing to admit that it may follow incomplete removal by the knife. But every surgeon of experience must admit that nearly always the more active varieties of sarcomata, the large spindle and small round-celled varieties, the latter particularly, are made worse and life is shortened by incomplete removal. In such circumstances a masterful inactivity on the surgeon's part is best.

It is now accepted that gastric ulcers, diverticulitis, pericæcal inflammations, and benign tumors undergoing inflammatory action so closely at times mimic malignancy as to baffle the most experienced and observant surgeons. Consequent upon and with the appreciation of this fact, few instances of supposed cure have followed exploratory and incomplete operations for abdominal cancer, and fewer still are likely to be reported subsequently. This is a day for cold, hard facts, and not for the perpetuation of surgical vagaries that had birth in the fancy of observers who, however able, were not possessed of the means now employed and accessible to all.

Further, even if I could be convinced that occasionally an undoubtedly carcinomatous mass may in some strange, vague and inexplicable manner pass away, I should still look

with disfavor upon partial removal. It is just as likely, more so I think, to happen if not stirred and whipped into an unwonted activity by incomplete operations; for often have I witnessed the latter, but never, I repeat, the former process.

A further, better and less speculative reason for non-interference is that the surgeon should not hold himself higher than the law which says "the greatest good to the greatest number." Great as our obligations to individual patients are, they are greater to all of our present and future clientele and to the cause of surgery. No one can or will deny that the best of laws, under the most beneficent government, exceptionally work individual hardships. Finally, such belated and ill-starred procedures first raise, then destroy false hopes in patient, family and friends and in addition thereto cause needless anxiety, suffering and expense. Palliative operations for the relief of pain, dyspnœa, pyloric, intestinal or other forms of obstruction are manifestly proper and should be done, even more frequently than they are, but only with the thought of relieving a definite symptom and not with the slightest hope of effecting a radical cure. Moreover, such a purpose should be fairly stated to the family of the patient, so that responsibility can be placed where it rightfully belongs. Were this always done there would soon come a better appreciation, professional and lay, of the inestimable benefits of early operation and, as surely, the infinite hazards of delay. And with it will come, what is desirable, a public sentiment which demands early operation in superficial lesions that are apparent and exploration in deep-seated ones which, from their nature are not apparent.

Let us turn from inoperable to operable cancer and see what can be accomplished if such patients are divided into early, fairly early, and late or unfavorable cases, the same classification made of patients with acute affections such as appendicitis, peritonitis, strangulated hernia, intestinal obstruction, diseases of the gall-bladder, etc.

The pessimist, and he is still about, will find as much to make him decry operative results in any of the above conditions

as in cancer, if he will only consult the various hospital reports the country over and then make a sum total of the enormous number of unnecessary deaths resulting from conditions which were once simple, local, and therefore, nearly always curable by early operation. It is needless for any member of this Academy to take that trouble, as it is only necessary for him to recall how often he and his assistants are telephoned to, and then usually at night, or worse, the wee, sma' hours of morn, to see, for the first time, some valuable member of society either actually dying, or in a condition to preclude operation at the hands of any surgeon of judgment. There will be others, again, so extremely ill that one thinks carefully, balancing every argument for and against operation before coming to a decision; others still more favorable from an operative standpoint, and yet toxic enough, through delay, to make the operator think many times as he prepares for operation, how much better it would have been if some one had not already blundered. Surgeons are largely responsible for such a condition in all of our hospitals, for just so long as they are willing and continue to operate upon such patients, just so long will they be furnished.

That such patients with acute disease sometimes unexpectedly recover after operation is, of course, quite true, and justifies the taking of many chances. But such is not true of advanced carcinoma, where a reasonable knowledge of pathology makes it next to certain that nothing can or should be done in the way of surgery. We are not depriving the patient of any chance at all, or one so slight as to be negligible, whereas we are giving others their chance of an early and beneficent operation by compelling them to see and understand the value of timely action. Is there a man here who has not seen one or many women conceal from their relatives and friends tumors of the breast, on account of their dread of an operation, giving nearly always the same reason—that some friend had been unsuccessfully operated upon?

But to be more specific and less general, let us consider briefly a few facts made plain by the last report of the Cancer

Commission of Pennsylvania, prepared with great care by its Chairman, J. M. Wainwright.

There were four hundred cases reported by surgeons throughout the State and, while the number is not great, it is enough to give a fairly accurate knowledge of conditions which obtain in Pennsylvania. Bad as they are, the statistics probably indicate a more favorable condition than actually exists, as a record is usually not made of the most advanced cases which do not come to operation at all.

Only 68 per cent. of the superficial carcinomata and 48 per cent. of the deep-seated ones are operable when first seen by a surgeon. The superficial lesions had been apparent to their hosts eighteen months before a surgeon was consulted, and in deep growths well-marked symptoms of the disease had been present fourteen months. In superficial growths thirteen months had elapsed, on an average, between the time the family physician was first consulted and the date of operation; and in deep-seated ones, a year.

In 3 per cent. of the cases of cancer of the breast the physician first consulted failed to make a local examination, and in 13 per cent. advised local applications or "waiting to see what develops."

In gastric cancer the first physician consulted made no local examination in 9 per cent. and gave bad advice in 20 per cent.

In cancer of the cervix no local examination was made in 10 per cent. and bad advice given in 20 per cent.

In cancer of the ovary no local examination was made in 14 per cent. and non-intervention advised in all of them.

In conclusion Wainwright says: "This work was undertaken to show, if possible, just where the greatest responsibility lies. It is, of course, to be proportioned to the medical profession on the one hand and the general public on the other. There is the greatest possible room for improvement in both, but of the two it would seem that the medical profession should show a marked improvement first. We cannot view with complacency the fact that, as a general average, cancer patients

have been under the care of their family physicians more than a year before they applied for a radical cure."

This report shows clearly enough that only a comparatively few patients afflicted with cancer get the benefit of an operation while the disease is local, simply for the reason that metastases will, in the vast majority of instances, have occurred before a surgeon is consulted. If only a single one of the nearest lymph nodes be involved the disease is no longer local, but becoming general, and the chance of cure less than one-third what it would have been had operation taken place before such involvement. For instance, in the cases of mammary cancer operated in the Johns Hopkins Hospital since 1889, 80 per cent. of those without glandular involvement, and only 25 per cent. of those with axillary infection, were cured.

I am not aware that any one has attempted to indicate just when the lymphatic glands first show involvement in the several regions of the body where carcinomata frequently arise. It is safe to assume that it very generally does occur within a twelve-month on an average. In cancer of the tongue, mouth, breast, and cervix uteri it will take place sooner I feel certain, and in the skin, lip, large intestines, and rectum, probably later. The little knowledge we now have is conjectural and based upon the time when there is palpable enlargement. This avails next to nothing, as it will vary with the accuracy of the local examination, the region, and the amount of fat and other tissues superlying such enlargement.

In the mammary gland cancer will cause palpable enlargement of the axillary nodes in rather more than a year; according to Gross (15.6 months), Winiwarter (14.7), Oldekop (16.5).

Finney states that such enlargement occurred in the patients treated at the Johns Hopkins Hospital in from ten to thirteen months, and that 84 per cent. of such patients showed axillary involvement when first consulting the surgeon. Of W. T. Bull's series 65 per cent. showed palpable enlargement when he first saw them. Finney's opinion is undoubtedly nearer the truth, based as it is upon a larger number of cases and formed at a much later date, when the significance of such involvement is

so much better appreciated. In my own series of private cases enlarged axillary glands could be felt, or at least I thought so, on an average of 11.2 months after the patient noticed the original growth. But to show how misleading such evidence is, nearly all of my cases, early and late, exhibited demonstrable enlargement when the axilla was dissected. But when the microscope would have first shown evidence of the transference of cancer cells from the original focus to the nearest lymphatic gland is what we would like to know. That it varies with the age of the patient, site and variety of the growth is probable. Young women with numerous and patent lymphatics present earlier and more general metastases and therefore are less favorable subjects as a rule for operation than elderly women. Yet it is my opinion that too forcible and dogmatic statements have been made concerning the prognosis of cancer in young women. One of the best known pathologists, connected with one of the largest clinics in the country, recently wrote: "The woman under thirty-five years of age with carcinoma of the breast who lives more than two years after its discovery, however early and however radical the extirpation, is almost unknown."⁶ I have had many such patients.

One, twenty-one years old, operated on in May, 1900 (adenocarcinoma), has since married, borne at least two children and is perfectly well. No axillary involvement.

Another, twenty-four years old, operated on June, 1904, is now a trained nurse and is robust in every way. Tumor was a typical scirrhus with moderate axillary involvement.

Another, thirty-three years old, had a typical scirrhus with considerable axillary involvement, so great, indeed, that on account of it and her youth I gave a very gloomy prognosis to her physician and family, predicting recurrence within a year. She has seen me regularly since, and on the fifth anniversary of her operation (March, 1913), she was examined and found to be free from recurrence.

A fourth and still more significant case was that of a young woman thirty-three years of age, sent to me from Wilkes-Barre.

* Wilson, St. Paul Med. Jour., June, 1913.

She was nearly five months advanced in pregnancy when she was operated upon in the Jewish Hospital, in November, 1905. She had a typical scirrhus of the left mammary gland with moderate axillary involvement. At the present time, nearly eight years after operation, she is perfectly well.

That metastases to axillary and even supraclavicular glands may occur very early, and not in young women either, is shown by the report of another case. A maiden lady, fifty-six years of age, was sent to me for operation on June 3 last. She had not the slightest knowledge of any trouble in her breast until five weeks previously. At that time there was a slight induration in the upper and outer quadrant of the right breast about one and a half inches from the nipple. It was painless. Very soon the entire breast became involved and three weeks later she consulted her physician. There was no history of trauma at any time. At the time when she visited me the entire mamma was involved, skin red, and its local temperature very much increased. It looked like an acute inflammation, as shown by the photographs and drawing which I had made. The axillary glands were greatly enlarged, so much so as to cause moderate œdema of the arm. There was also a lump in the subclavian triangle as large as an English walnut. The breast was adherent to the costal wall. The opposite mamma was quite normal and the axilla as well. It was recognized as a typical example, and the most acute one I have ever seen, of what Volkmann has described as carcinomatous mastitis. I declined to operate, as all of the four cases I had previously seen and operated on died; three of them within six months and one in fifteen months. A two weeks' trial of X-rays was made, at the end of which time she being no better but worse, radium treatment was begun. She was only able to take a few treatments, as her general condition grew rapidly worse. The entire breast became, so her physician Dr. Bird tells me, "as purple as an egg-plant." She died August 9, just three months after the disease was first recognized.

We have said that the location of the growth and its variety influence axillary and other metastases. Adenocarcinoma has little tendency to cause metastases, glandular or otherwise. Encephaloid or medullary cancer does so quickly. Scirrhus stands midway between them.

FIG. 1.



Growths in the outer hemisphere are likely to cause axillary and supraclavicular involvement earlier than similar lesions in the inner hemisphere; *per contra*, the latter the more surely and the more quickly cause involvement of the liver, mediastinum, vertebræ, and the opposite breast in the order named. From the arrangement of the lymphatic vessels this is just what should be expected. The mediastinum was, until recently, thought to be most obnoxious. Handley has clearly shown the liver to be more so. I am not certain that the mediastinum should even be placed second. My own series indicates clinically a larger per cent. of metastases to the bones, particularly the sternum, vertebræ, and long bones than to either the liver or thorax, and gives to them the melancholy distinction of first place. That the liver and lungs may both be more often found involved at autopsy I grant, but this may be, I think is, due to the fact that the abdominal and thoracic cavities are systematically opened and their contents carefully examined, while the osseous system, unless suspected, is not examined. That many metastases to liver and lungs occur subsequently to those in bones I have not the slightest doubt.

Terminal pathology is valuable, but the pathology of the living is far more so, and upon it surgery must advance if it does so at all. Many of my operations have been followed by intercostal neuralgia, paraplegia dolorosa, involvement, with and without fracture, of humerus and femur, before there were either symptoms or signs of abdominal or thoracic complications. A well-taken skiagram will usually locate the lesion.

In August, 1912, I was asked by my colleague, Prof. Anders, to see in consultation a woman from Illinois, who had been operated upon for carcinoma of the breast the preceding November by a distinguished Western surgeon. The patient had come East to spend the summer and had been taken in June, while staying near Boston, with intercostal neuralgia. Nothing seemed to give her relief but opium. Early in August she came to her sister who lives near Philadelphia. When I examined the cicatrix it was found to be smooth, supple, and absolutely free from disease.

Her only symptom was intercostal neuralgia. A careful examination of her back led me to believe that certain vertebræ were affected, and I gave her sister and husband a very guarded prognosis, plainly stating my fears. A skiagram was made the following day by Dr. Pfahler which served to confirm my opinion. The operator was at once written to for further information. His report showed an early scirrhus, and that a favorable opinion as to a radical cure had been entered in his notes. He was in every respect warranted in thinking so at the time, and certainly had done a very complete operation. During the next month the patient was, I learned, better, then worse alternately. Soon after her return home in October, or less than a year after operation, she died. Spinal metastases had taken place before operation and could not have been suspected. There is no other rational explanation of this case and the following ones in my own practice which are briefly outlined.

One of them, a married woman of thirty-two, was operated on in May, 1908, and died December, 1910, thirty-one months after operation. To the very end the cicatrix and surrounding structures were absolutely normal. Intercostal neuralgia began within a year after operation, and a palpable tumor of the spine, apparently beginning in the intervertebral disc between the eleventh and twelfth dorsal vertebræ followed later, a skiagram of which is shown. At the time of her death, from reports made to me, it must have been enormous. Strangely enough she did not have paraplegia, as the growth was forward instead of backward. She could not walk well, however, for a year before her death.

In January, 1909, I operated on a married woman, thirty-nine years of age, for a well-marked scirrhus with pronounced, but not extensive, axillary involvement. During the meeting of the Congress of American Surgeons two years ago she was one of thirty cases exhibited to show the post-operative result. Although the scar was perfectly normal, so was the axilla, and she had gained in weight, looked perfectly well and was doing all of the cooking and housework for herself and family, she reported to me that she was not sleeping well on account of a pain in her side at night. A careful examination convinced me that it was intercostal and probably the result of metastasis to a vertebra which was tender upon pressure. A skiagram was made the following day which

FIG 2.



FIG. 3.



confirmed my fears. The third and fourth lumbar vertebræ showed involvement.

In September, 1910, Mrs. C., aged sixty years, was operated upon for a large scirrhus of the breast with great axillary involvement, the extent of which was not appreciated, though it was palpable, before operation, she being a very stout subject. She had known of the enlargement in her breast more than two years. When I expressed surprise that she had allowed it to remain so long her reply was: "It does not hurt me now, I feel perfectly well and am only consenting to removal because my physician tells me that it should be done." There were no enlarged glands above the clavicle or evidence of abdominal or thoracic metastases. On this account, notwithstanding its duration and the marked axillary involvement, I was disposed to advise operation and give her the chance. After a most extensive operation she made a rapid recovery, going home in less than two weeks. To my surprise her health remained excellent for 13 months. She then began to have pain in her back and side. A skiagram showed metastases to the eleventh and twelfth dorsal and second lumbar vertebræ. She lived several months longer and I am informed that local recurrence was manifest at the time of her death. This was to have been expected from the duration and extent of the disease at the time of operation.

A fifth case, aged thirty-one, also well advanced in pregnancy, between 6 and 7 months, was operated upon in her house in this city, she declining to enter a hospital, in May, 1905. She was delivered at term of a healthy female child. Three years and four months later she was delivered of a healthy male child. She had seemed entirely well in every way until this last pregnancy, when a recurrence in the scar near the axilla was noticed in the last months of gestation. Thirty months after the first operation she called at my office with a friend, upon whom I had also operated for cancer of the breast, and both of them appeared absolutely free from recurrence. One of them is still well, more than eight years after operation. I was not again consulted until a month after her last confinement, at which time there was a large mass the size of an orange, almost ready to ulcerate. From the statements made by patient, trained nurse, and physician, the tumor must have grown with startling rapidity during the last month of gestation and the month of lactation. Such has been the progress

of most of the malignant tumors that I have encountered in pregnant women. In November, 1909, or forty-two months after she was operated upon she died of frightful convulsions which began a fortnight earlier. Prior to the first convulsion, and between the others, the patient suffered from severe headache and backache, due, I doubt not, to metastases to vertebræ and cranial bones, there being no other rational explanation of her symptoms. Her kidneys were sound but her liver was enormous. Drs. Musser, Miller and myself were of this opinion. Autopsy was not allowed.

I have records of another case operated on early in 1904 for Dr. P. S. Donnellan. Within eight months she began to have intercostal neuralgia and died within a year of apoplexy. She had what I have frequently called a "succulent" breast, plump, vascular, with the glandular tissue well marked and lymphatics abundant. I remember that Donnellan at the time of operation was struck with and questioned me as to the expression (succulent).

She had never borne children though married many years. Her age was forty-eight. There were probably both spinal and cranial metastases. I had never at that time employed the Röntgen rays for diagnostic purposes.

In addition to these five cases, which I saw during the final stage of their illness, I have letters from the family physicians or others which cause me to suspect that they, too, died of spinal metastases. I have records of two very interesting cases treated in Louisville, Ky., where the osseous system was involved. In one of them a spontaneous fracture of the surgical neck of the left humerus followed a large scirrhus of the left mamma which the patient concealed from me for weeks. She was never operated upon. The fracture was slow to unite, her appearance suggested cachexia, and when pressed closely, but only then, did she show me her breast. I had noticed that although an elderly married woman, her breast was always artfully concealed even when my dressings were applied. I thought I had never seen one so modest. When I saw a large mass ready to ulcerate the reason for the slow union of her fracture was apparent.

The other was a maiden lady, fifty-five years of age, the daughter of a prominent surgeon and the sister of a physician. Although she knew of a tumor in her breast for twenty years she never mentioned it to either father or brother. When she came to my office with a younger but married sister she would not allow

her to enter my consulting room. She explained to me that she had kept it a secret from her family and friends and had only been made to seek advice on account of the very rapid growth of the mass during the previous few months. It was not painful. Sarcomatous degeneration of a benign tumor seemed clear. After much insistence she accepted operation. It proved to be sarcoma. In six months she began to complain of rheumatism in her right hip. In time a tumor of the femur, showing in Scarpa's triangle, developed and before her death attained large size. There was never local recurrence. I was absent from Louisville when she died and no autopsy was made.

I have reported these cases and could cite others to show how frequently, and how early metastases to the osseous system may take place. So unhappy has been my experience of them that when one of my operative cases, which I had considered relatively safe, begins to complain of intercostal neuralgia, backache, or rheumatic pains uninfluenced by antirheumatic treatment, I am disposed to throw up my hands and await the inevitable.

I expressed this opinion to the late Maurice H. Richardson, who was at the clinic above referred to and who spent four hours with me examining all the patients, gross specimens and microscopical slides. He agreed with me that the bones were more frequently involved than is generally believed and said that his experience had been much as my own. America has produced few surgeons with so wide an experience, who observed and thought so accurately and who always reported his convictions so conscientiously. One always felt after Richardson had spoken on a subject that the last word had been said.

But unexpected manifestations, such as above detailed, in a disease so protean in its nature as cancer, while discouraging, should also emphasize the necessity for earlier operation. There was a time when every one of the cases I have referred to could have been saved. A time when the original focus in the breast was inconceivably small, a diseased cell, a germ, something, we know not exactly what, but we do know that

for a time it is strictly local. It may remain so for weeks, months or years, varying with the organ affected, the abundance of its lymphatic supply and possibly other influences of which we know little. The evidence that carcinoma is at first strictly local is so complete and overwhelming as to leave no possibility for doubt, if one carefully considers it and is uninfluenced by the masters of a former generation, who were as slow to acknowledge and put into practice the discovery of Moore as they were to accept the inestimable blessing offered to them by Lister.

If the disease were constitutional one could never hope to effect a cure by local measures, and so long as they were practised in a partial, incomplete, and faint-hearted manner upon unfavorable cases a cure practically never resulted. But when operative limits were extended even unfavorable cases were sometimes, but rarely, cured. More extensive procedures upon average cases brought a still greater measure of success, and now, free removal of early lesions is generally followed by a permanent cure. Operations for mammary cancer yield 80 per cent. of cures if practised before the disease has spread to the nearest lymph-nodes, and a larger per cent. of early, strictly local carcinomata of the lip and larynx yield to excision. According to Judd, 93 per cent. of the traced cases of epithelioma of the lip at the Mayo clinic were permanently cured. Sir Felix Simon reports 85 per cent. of cures in local laryngeal growths.

But, unfortunately, there is no way by which a clinical diagnosis of cancer can be made with certainty even after it has ceased to be strictly local; much less can it be done beforehand. Taking all cases as they present themselves to us at the present time—early or local ones, fairly early or those with moderate involvement of the nearest chain of nodes, and unfavorable or late ones, in other words, where there is greater infiltration of the tissues around the original focus and more extensive glandular infection, but still safely removable by the knife—we must be content with a number of five-year cures ranging from 10 to 50 per cent. and upward, varying with

the organ, variety of growth and whether the part affected is deep or superficial. For example, carcinomata of the alimentary tract from mouth to anus are permanently curable in about one-fourth of the cases (Butlin, Kocher, and Mayo); whereas carcinomata of the mammary gland give upward of 50 per cent. of five-year cures (Cheyne, Dennis, Rodman).

It is true that I have selected the best available statistics, as we will never be stimulated to greater endeavor in any other way. We want and should only be satisfied with the best, not average results.

Great an advance as this is over what was accomplished formerly, we cannot view existing conditions with indifference and should aim at something which will save nearly all, instead of half our patients. There is but one way in which it can possibly be done, and that is by operating in the precancerous stage. I am well aware that the term "precancerous" will be objected to for at least two reasons: first, that there is not always a precancerous stage; second, that when it does exist it does not necessarily mean that cancer must eventuate. Both objections are granted. The term is a convenient one, however, and in the lack of more accurate knowledge as to the exciting cause of cancer we are justified clinically in its use. I had hoped to show, and will do so in a future communication, that there are definite conditions precedent to carcinomata, variously situated, far more frequently than has been appreciated.

These conditions may be internal as well as external, and are frequent and suggestive enough to warrant the term "precancerous" and, when encountered, demand a more radical treatment than has hitherto been accorded them. Furthermore, that prompt and efficient means, entirely within our reach, nearly always either cure incipient carcinomata or, what is still more desirable, prevent them. Moreover, and it is to say the least suggestive, that such precancerous conditions are inflammatory, inasmuch as a mild, low-grade, chronic inflammation, due to long standing irritation and resulting in either ulceration, hyperplasia, or cicatricial tissue, is present in all of them.

This, in turn, means diminished arterial supply with lessened physiologic resistance of the cells undergoing metaplasia. While there may be in addition something more necessary, extrinsic or intrinsic, to initiate the cancer process, this much is always present, a suitable soil, if you please, and would seem enough in itself to cause cancer.

The past month has been a notable one in bacteriology, inasmuch as Noguchi and Flexner, of the Rockefeller Institute, have definitely reported the discovery of the germs causing rabies and infantile paralysis respectively. Cancer may be the next enemy to capitulate, and, if so, let us hope that it will be to either one of these distinguished investigators, or some fellow countryman.

And yet it does not follow that a positive demonstration of the microbic origin of carcinoma will be immediately, or soon, followed by the discovery of a cure. Let us not forget that for more than thirty years the cause of tuberculosis has been known, and yet a remedy for it has not been found. Let us also hold fast to that which is good and known to be effective, early and radical operation, and, keeping constantly before us the unpleasant fact that the cancer menace is an ever-increasing one, in this and every country, threatening, though not so frequently, the young as well as those of middle and maturer years, and the further fact that its diagnosis in the incipient stage is difficult always, and oftentimes impossible, will not our most fruitful results unquestionably be in the direction of preventive rather than curative operations?

THE LOCALIZATION OF FOREIGN BODIES WITHIN THE TISSUES, WITH A DESCRIPTION OF A METHOD OF LOCALIZATION.

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OFTENTIMES the search for a small foreign body within the tissues is protracted and fraught with considerable difficulty in spite of the fact that its position may have been accurately determined theoretically by one of the present methods of localization. These methods are rather complex and require careful mathematical calculation and, some of them, special instruments. Consequently a simple clinical means would seem to be desirable.

A review of the methods thus far described for locating accurately foreign bodies within the tissues of the body allows them to be divided into two classes: 1. The localizing of the foreign body, if metallic, by the electric searcher, and 2, localization by stereoscopic radiography.

1. *Localization by the Electric Searcher.*—The metallic electric probe has been in use for many years but it is of value only in cases in which there is an open tract leading down to the foreign body. As a result the instrument is useful chiefly in gunshot wounds.

Thomas,¹ for locating metallic foreign bodies, makes use of a telephonic searcher. This consists of three needles mounted on a handle and so wired that contact of any two of the needles with a metallic object completes an electric circuit and rings a bell. The instrument is advocated as an aid in operation and is used after an incision has been made through the skin. The needles are thrust into the tissue in various directions until the foreign body is encountered. Immediately upon touching the foreign body the bell rings, the sound being

transmitted to the ear of the operator through a telephone receiver. The current is turned off, searcher left in place, and the foreign body cut down upon, using the needles as a guide.

2. *Stereoscopic Radiography*.—Cole² reviews the methods of radiographic localization and goes on to describe his own. Two separate radiographs are taken. One to locate the position of the body and one for measuring its depth from the surface. In the first plate two coins are placed on the part, one on the anterior and one on the posterior surface, in such a way that the rays from the anode will pass through coins and foreign body and the three objects will cast but a single shadow upon the plate. When these conditions are fulfilled the position of the coins is marked upon the skin with silver nitrate. The body must lie upon a line projected through the two coins. In order to ascertain the line with accuracy the coins must be placed under the fluoroscope or several attempts with skiagraphs may be necessary, each time moving the coins until finally all three bodies cast a single shadow. In order to determine the depth of the foreign body from the surface, two exposures are made on a single plate. After the first exposure the tube is moved a short distance, the distance noted and a second exposure made. The skiagraph shows two shadows of the foreign body. By measuring the distance between the shadows on the plate, the depth of the body in the tissues can be determined accurately by means of the following fixed quantities: (a) distance of anode from plate, (b) distance between anodes at the two exposures, (c) distance between the shadows cast in the two exposures.

The above method embodies the principle employed in locating foreign bodies in the tissues by the X-ray, namely, triangulation of the planes of the shadows cast by the foreign body with the tube in two different positions. Brickner³ modifies the method somewhat and makes use of special apparatus. Sweet⁴ employs a rather complex apparatus and calculates the position of the foreign body by the relation between its shadow, that of a fixed marker on the upper surface of the part and that of a pair of crossed hair lines lying on the surface of the

photographic plate. Fürstenau, cited by Reichmann,⁵ has perfected a special instrument (roentgentiefenmesser), by which the depth of the foreign body and its position with relation to a surface marker can be read off upon a scale. The instrument is made in the form of a pair of calipers with two arms, and carries two scales.

The above methods leave nothing to be desired in the way of theoretical accuracy. They are, however, very exacting technically and, on account of the special instruments required, it is not always feasible to carry them out. Measurements are, as a rule, made from fixed bony points and this allows for the possibility of two forms of error. The distance from the shadow cast by the bony point to that cast by the foreign body does not correspond to the distance between the actual objects in the living body. The reason for this has been pointed out by Cole.² There is also the error due to personal equation between radiologist and surgeon in taking the measurements. A further difficulty for the surgeon presents itself in that in some of the methods there is no mark upon the surface of the body to follow at the operation, and in others there is only a small silver nitrate spot.

The following method of localizing foreign bodies is suggested as being simple, accurate, and requiring no apparatus beyond the usual X-ray outfit.

Technic.—A preliminary radiographic examination for the purpose of substantiating the diagnosis is made and the approximate position of the foreign body noted. The area of skin over the foreign body and a surrounding area of a few inches is then prepared in the following manner: Vertical and horizontal lines running at right angles to each other are painted upon the skin with silver nitrate solution, thus laying the skin out into squares (see Fig. 1). The size of the squares can easily be made to bear a proper relation to the size of the foreign body on the one hand and that of the part to be prepared on the other. As a rule, one inch squares will be found very convenient. The component lines of the checker board thus formed are numbered for the purpose of more easily locating the individual squares. The

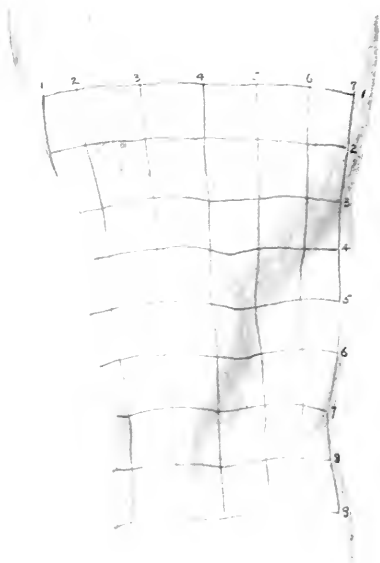
area thus painted should include one-half the circumference of the part. As an example, in the knee the first vertical line should run along the antero-internal margin of the knee and the last along the postero-external. The horizontal lines should connect the vertical. If the entire circumference is laid out in squares, the lines of one-half the circumference should be solid and those of the other half dotted. The reason for this will be apparent. The silver solution is allowed to turn black and the skin thus stained. The lines are then painted over with white lead paint and this allowed to dry. Two radiographs are now taken, one, anteroposteriorly and one, laterally, the target of the tube being placed directly over the position of the foreign body as shown in the preliminary skiagraph. The resulting skiagraphs show the shadow of the foreign body with relation to the squares painted upon the skin. By projecting imaginary lines from the shadow of the body in the two positions with relation to the overlying lines, its approximate depth from the surface is easily calculated. If the entire circumference of the part has been painted, the position of the body is noted accurately by projecting the point of intersection of the shadow with the solid line on one surface to its point of intersection with the dotted line on the opposite surface. If desired, a tracing of the lines and the shadow of the body may be made on a transparent paper and this tracing laid upon the skin so that the lines of the squares correspond accurately. The shadow of the foreign body may then be marked upon the skin with silver nitrate to be used as a guide at operation. Following the radiographic examination the white lead is removed and the part placed at rest until operation.

This method has been employed in three instances in the First Surgical Division of Bellevue Hospital, New York City, in the services of Drs. John B. Walker and Lucius W. Hotchkiss, to whom I am indebted for the privilege of making this report.

In each case the foreign body (a needle) had moved a considerable distance from its point of entrance and in none of the cases could it be palpated.

CASE I.—*Needle in the knee* (Figs. 2 and 3). One month before admission the child fell, driving a needle into her knee. The knee is held in flexion of 160° and extension is painful. After radiographic localization an attempt to remove the foreign body by operation was made and after a search of fifty minutes

FIG. 1.



Knee showing lines painted upon surface.

FIG. 2.



Case I. Anteroposterior view of knee.

FIG. 3.



Case I. Lateral view of knee.

FIG. 4.



Case II. Needle in the back.

FIG. 5.



Case III. Anteroposterior and lateral views of foot.

it was given up. Subsequent to localization by the method above described, an oblique incision across the shadow of the needle in the appropriate square resulted in its removal. The entire time of operation, including the joint repair, was fifty minutes.

CASE II.—*Needle in the back* (Fig. 4). Two weeks before admission a child thrust a needle into the patient's back and the needle broke. The point of entrance was situated on the left side about two inches outside the outer border of the erector spinæ muscle. The radiograph taken after the skin had been marked out into squares showed the needle lying approximately in the long axis of the body near the spinous process of the third lumbar vertebra and traversing the longitudinal extent of one square. An incision over the appropriate square disclosed the needle lying beneath the aponeurosis in the substance of the erector spinæ muscle. It was recovered at operation in five minutes.

CASE III.—*Needle in the foot* (Fig. 5). This case disclosed the fact that it is necessary for the operator to know the position of the tube at the time of skiagraphic examination. Five days before admission the child stepped upon a needle, driving it into the sole of the foot and breaking it off. The point of entrance was half an inch external to the inner border of the foot and half way from the posterior border of the heel to the first metatarsophalangeal articulation. Skiagraphic examination, after the skin had been prepared according to the above method, showed the needle obliquely placed, nearer the outer border of the foot than the inner and lying across two squares, the base of the needle about half an inch from the surface. As the X-ray tube could not be placed directly above the foot when taking the skiagraph because of the presence of the leg the rays met the photographic plate at an oblique angle. As a result the shadow of the needle in its relation to the surface lines was shifted because the surface lines rested directly upon the plate while the needle was deeper in the tissues and consequently farther away, hence, the rays had to travel a distance of from half an inch to an inch in an oblique direction before striking the plate. During the first part of the operation this was not taken into account, but when the needle was not found immediately, the source of error was recognized and a slight lengthening of the incision in the proper direction resulted in the finding of the needle. Time of operation, twenty minutes.

It is in such a case as this that the painting of the part over the entire circumference will prove of value as it will allow of through-and-through projection of the shadow from a fixed point on one surface to a fixed point on the other.

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PNEUMOCOCCIC ARTHRITIS.

BY KENNETH BULKLEY, M.D.,

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PNEUMOCOCCIC arthritis is a comparatively rare disease. Were it not for this fact we would feel some hesitancy in writing a paper following but one observation. However, in attempting to obtain data, we found that the statistics given were somewhat misleading, due no doubt to the compilation of a relatively small number of cases. This led us to review the cases already collected and to collect such additional as were available, including, as far as possible, only those cases in which the arthritis was proved to be due to the pneumococcus. For this reason a number of reports found in previous compilations will be found missing from this paper.

The excuse for this paper and the material on which it is based consists of reports of 172 cases collected from the literature to which we have added one case coming under our own observation. The history of this case is as follows :

J. B., male, age eleven months, fourth child. Normal birth, breast fed for three months. Well until $4\frac{1}{2}$ weeks ago when he developed a left lower lobe pneumonia. During the course of this pneumonia the right shoulder became somewhat swollen and tender. The swelling increased slowly until three days before admission, but since then the increase has been rapid.

Patient admitted to the Presbyterian Hospital, where he was first seen by the writer, on March 28, 1911. Examination showed a poorly nourished child, otherwise apparently healthy except for the local condition. At the site of the right shoulder was a rounded swelling occupying largely the anterior and lateral aspect of the joint. Skin over it white, but numerous large dilated veins were evident. Swelling was about the size of a mandarin orange, soft, fluctuating, and moderately tender. No crepitus. Length of arm normal. Motion of arm limited, apparently by pain. Temperature 101.2° , pulse 142, respiration 36. Leucocytes 34,000,

polymorphonuclears 78 per cent. Cultures from throat showed staphylococci and pneumococci.

On the day after admission the shoulder-joint was aspirated and 130 c.c. of greenish-white creamy pus was obtained. Cultures from this showed a *pure growth of pneumococcus*. The joint was again aspirated on the following day, and 2 per cent. formalin in glycerin injected. As the child was becoming progressively worse, temperature 104° , an arthrotomy under cocaine was done on the anterior aspect of the joint, and considerable pus and fibrin were obtained. The structures within the joint felt normal to the palpating finger. The accompanying temperature chart shows the

FIG. 1.

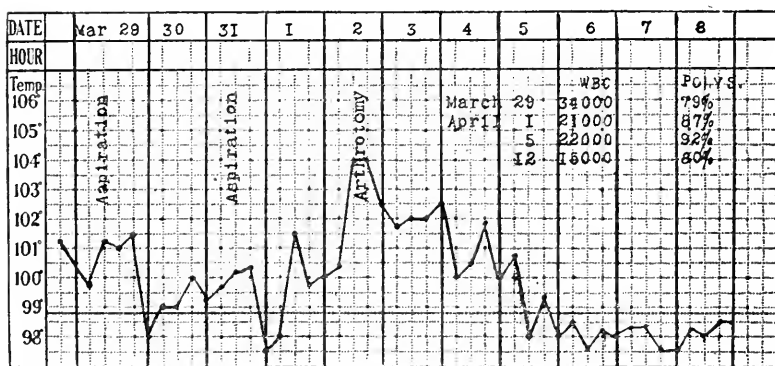


Chart of author's case. Note sudden fall of temperature after each aspiration and the rapid permanent fall after arthrotomy.

course of the disease. The drainage, at first profuse, gradually decreased, and on the eighth day the rubber drainage tubes were removed. Convalescence was uneventful and the wound rapidly closed. Some months later function was perfect and no limitation of active or passive motion could be detected.

Historical Note.—The pneumococcus was first discovered by Sternberg in 1880. In 1881 Volpian again described it in the sputum, and in the same year Ebert and Koch and in the following year Friedlander, Leyden, and Gunther showed it to be constantly present in the lungs of persons dying with lobar pneumonia. It was not until 1884 that Talmon first successfully isolated it in pure culture on artificial media. In the fol-

lowing years many authors described the presence of the pneumococcus in nephritis, meningitis and endocarditis complicating pneumonia, but credit for first finding the organism in the joint fluid is usually given to Foa and Bordoni-Uffreduzzi ³⁹ (1888).

The first completely reported case of arthritis in which the pneumococcus was isolated from the joint was described by Weichselbaum ¹³⁷ in 1888 although undoubted cases lacking bacteriological proof had been previously reported by Fournet (1839), Grisolles ⁵² (1864), Bouchard (1881), Maragliano ⁸³ (1882), Bourcey ¹⁶ (1883) and others. Since Weichselbaum's paper many cases have been reported and not a few notable monographs placed on record. Leroux, ⁷⁵ in 1899, collected 28 cases to which Cave, ²¹ in 1901, added 3, Cole, ²⁶ in 1902, added 9, Herrick, ⁵⁶ in 1902, added 21 etc., etc. Other notable contributions have been made to the subject by Pfisterer, ¹⁰⁴ Herzog, ⁵⁷ Gasne, ⁴⁶ Zesas, ¹⁴⁴ and other writers.

ETIOLOGY.

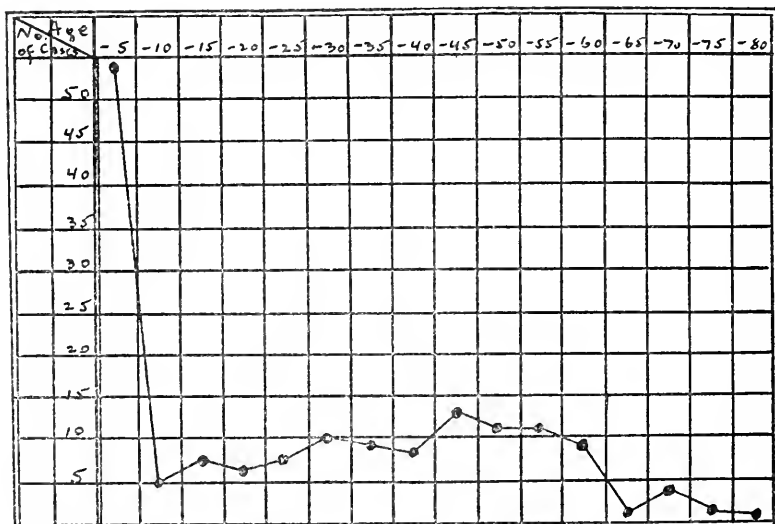
Incidence.—That the condition is a rare one is shown by the comparatively few cases on record. We have been able to collect only 172 cases although the condition was first described 25 years ago. Its frequency in relation to pneumonia is generally given as about one in eight hundred, Table I showing one arthritis in each 727 of a total of 12,364 cases of pneumonia collected. Raw ¹¹¹ found the remarkably high figure of 1 per cent. in his London cases, but the majority were alcoholics, a condition predisposing to arthritis.

TABLE I.
Number of Cases.

Reporter.	Source.	Pneumonia.	Arthritis.
Herrick.....	Collected from German Clinics.....	2,292	2
Vogelius....	Charite, Berlin	3,293	2
Vogelius....	Munich Hospitals	650	1
Vogelius....	Paris Clinics	1,215	3
Leroux.....	Collected from Germany	4,256	6
Chatard.....	Johns Hopkins Hospital	658	3
		<hr/> 12,364	<hr/> 17

Age.—The condition was first described as one of late adult life. Gasne,⁴⁶ however, in 1908, was able to collect 52 cases in children under 2 years of age, and in our series 53 cases or 34 per cent. have occurred during the first hemidecade. It is unfortunate that Gasne did not publish the details of his cases, as many of them we have been unable to trace. Fig. 2 represents graphically the age incidence. The youngest case in the series was 11 days old and the oldest 79 years.

FIG. 2.



Showing the number of cases occurring in each hemidecade.

A close survey of the chart shows a large number of cases under the age of five years, a sudden fall, then a gradual increase up to the twenty-fifth year. A rather uniform number occurs during each five year period from then until the sixtieth year, when the number of cases rapidly decreases. We can thus accurately state that the disease is more common during infancy than in any other period of life, a statement which, in 1910, Howard⁶³ thought we were not warranted in making. Herzog⁵⁷ believes that children are particularly susceptible to pneumococcus infections of all sorts, and particularly to arthri-

tis. Dudgeon and Branson³⁰ have shown that while suppurative arthritis is uncommon during the first 6 months of life, the causative agent is in the majority of cases the pneumococcus. Herzog³⁷ explains the frequency of infective arthritis in infants by the peculiar structure and vascular arrangement of the bony rudiments of the joint. He quotes Neumann who has shown that the capillaries of the bone marrow in infants are of larger calibre than the smallest arteries, an arrangement whereby the blood current is rendered extremely slow and the deposition of infective organisms in the tissues is favored. The number of cases occurring between the ages of 25 and 60, the period of greatest activity, is probably explained by trauma, etc., a point which we will later discuss in detail.

Sex.—There were 102, or 65 per cent. males, and 53, or 35 per cent. females, in our series. In 18 cases the sex was not mentioned. Earlier writers have all given a still higher proportion of males. This disproportion has usually been ascribed to the influence of trauma which unquestionably, predisposes to infection and to which the male is more subject than the female. In order to determine this point we have analyzed the sexes above the age of 10 years, assuming that below that age trauma plays an indifferent or at least an impartial rôle. We found approximately 78 per cent. males and 22 per cent. females, quite a contrast with our original figures of 65 per cent. and 35 per cent., respectively!

Predisposing Factors.—Besides the acknowledged fact of the lack of resistance of synovial membranes to infection, there is strong evidence that partial immunity of the host or decreased virulence of the organism play their part in the joint localization. Bezancon and Griffon,¹¹ working with the pneumococcus, were unable experimentally to produce alone an arthritis in rabbits without first partially immunizing them by repeated inoculation of non-virulent cultures. They concluded that pneumococcus arthritis was more apt to appear with a culture attenuated by age, or by an enormous dose into an animal rendered relatively immune by previous vaccination. Lippmann⁷⁸ believes that a pneumococcus of feeble power having

broken into the circulation is unable to produce a generalized infection, is repelled by the stronger tissues, and finally gets a foothold on a serous articular surface. This theory is supported clinically by our statistics. In 73 cases of our series in which the arthritis followed a pneumonia eleven days was the average time elapsing between the onset of the pneumonia and that of the arthritis. This is exclusive of two cases (Popescu¹⁰⁷ and Schuster¹¹⁹) in which the arthritis followed the pneumonia four months and 20 years respectively. This long period before the onset of the arthritis argues strongly in favor of the development of a partial immunity, or of an organism of decreased virulence, or both.

Trauma and previous joint disease unquestionably play their part also, as is shown by both experimental and clinical evidence. As to experimental evidence we can do no better than quote the summary made by Cole,²⁶ of work in this line. It is as follows: 1. Injection of virulent cultures of the pneumococcus into the joint of a susceptible animal is almost always followed by acute suppurative arthritis. 2. Subcutaneous injections after previous excitation of an aseptic inflammation of a joint give results some positive and others negative. 3. Intravenous injections (with conditions as in 2) are more apt to give a positive result. The first condition we have not encountered in the literature, no cases of punctured wounds of joints followed by pneumococcus arthritis having been found. Neither have we encountered the second condition in which a subcutaneous infection by the pneumococcus has given rise to a pneumococcus arthritis, although a number of cases of cutaneous and subcutaneous infection (Judd,⁶⁵ Powers¹⁰⁸) have been reported. The third condition is reproduced almost identically in man, for Rosenow¹¹⁵ was able to demonstrate the pneumococcus in the circulating blood in 91 per cent. of 175 cases of pneumonia. And this is where trauma and previous joint disease play their part. In 24 per cent. of our cases we have found cause for a *locus minoris resistentiæ*. This figure is lower than those given by Leroux,⁷⁵ Cave,²¹ Cole,²⁶ Pfisterer,¹⁰⁴ and Herrick,⁵⁶ but, nevertheless, we consider it

high enough to definitely indicate the rôle played by trauma, previous joint disease, and chronic systemic infection and poisoning. The conditions mentioned were as follows:

Rickets	4
Previous tuberculosis of joint	1
Injury	6
Alcohol and injury	2
Rheumatism	11
Injury and rheumatism	2
Plumbism	2
Gout and plumbism	2
Previous typhoid arthritis	1
Syphilis	4
Alcoholism	9
Marasmus	1
Gout	1

Relation to Pneumonia.—The cases may be classified according as to whether they have occurred during or after a pneumonia (meta- or postpneumonic), before a pneumonia (prepneumonic), or independently of any inflammatory lung lesion. Our cases may be divided as follows:

Following a pneumonia	73
Preceding a pneumonia	5
Pneumonia associated with arthritis but relation not stated....	38
No pneumonia	48
Presence or absence of pneumonia not stated.....	9

173

It is thus seen that 70 per cent. of the cases are associated with a pneumonia, and that 93 per cent. of these follow and 7 per cent. precede the lung lesion.

The meta- and postpneumonic cases are thus in the vast majority, Bourcey¹⁶ considering that most of them occur during the stage of red hepatization. The duration of time between the onset of the pneumonia and that of the arthritis varies from one day to 20 years (Schuster¹¹⁹), and averages (excluding the long cases of Schuster,¹¹⁹ 20 years, and Popescu,¹⁰⁷ 4 months) about 11 days, arthritis being more liable to follow a pneumonia in adults than in children.

The prepneumonic cases are rare, Howard ⁶³ even considering their occurrence questionable, but we have encountered five and must accept them. In two cases the pneumonia is described as occurring a few days after the arthritis, in one case as 4 days, one as 5, and one case (Furrer ⁴¹) as occurring six months after the arthritis. To us it seems quite possible that the usual routine should be at times reversed, the joint becoming infected first and the lungs later. We do not consider these, however, to be necessarily cases of primary pneumococcus infections of joints, but rather as cases in which the coccus has gained entrance to the blood stream either through the lungs, tonsils, pharynx, middle ear, or vagina, etc., causing lesions clinically undetected.

The cases not associated with any pulmonary involvement are of more interest and comprise the surprisingly large figure of 29 per cent. of our series, this condition having been found 48 times. Of these, 27 cases, or 59 per cent., occurred in children under ten years of age and 19, or 41 per cent., in older individuals. In the first group a primary localization of the pneumococcus is mentioned in 55 per cent. of the cases, while among the older individuals it is noted in but 36 per cent. Of the 48 cases not associated with pneumonia only 18 are noted as having some focus of pneumococcus infection previous to that of the joints. It will be noticed that most of the cases (15 out of 22) in which the primary focus was discovered were in children. These are as follows:

Infection of harelip wound (infant)	1
Conjunctivitis (infant)	1
Measles (infant)	1
Varicella (infant)	1
Bronchitis (infant)	2
Influenza (adult)	1
Cystitis (adult)	1
Pyosalpinx with umbilical fistula (adult)	1
Enterocolitis (infant)	2
Tonsils and pharynx (adult 1, and infant 2)	3
Suppuration at umbilicus (infant)	1
Abscess of thigh (infant)	1
Otitis media (infant 3, adult 2)	5
Labor and peritonitis (adult)	1

In the remaining 26 cases we believe that the primary focus or point of entrance of the organism was not found, but was nevertheless present. These cases have often been classed as primary and possibly correctly so. Allen and Lull³ reported their case in 1901 as the first primary case on record, while a year later Cole²⁶ classified 9 cases as primary. The question is largely an academic one hinging on whether the pneumococcus can traverse a mucous membrane without causing a lesion of the same, or whether this lesion if present shall be called the primary focus and be disregarded. For our part we prefer to consider all the cases as secondary, arguing that the joint can only be infected through the blood or lymphatic streams and that the organism in order to reach either of these systems must traverse the epithelial covering of the body, either skin or mucous membrane, and in so doing cause a lesion, no matter how small, which actually is the primary focus.

PATHOGENESIS.

In the meta- or postpneumonic cases the portal of entry is unquestionably the respiratory tract. In the prepneumonic cases and in those not associated with a pneumonia the point of entry is varied. In many cases it cannot or is not found, 29 of our 47 cases. Probably in the majority of these cases, as pointed out by Herzog,⁵⁷ the portal of entry is the middle ear. Especially is this true in children. Zeufel (quoted by Howard) found 40 per cent. of the cases of otitis media in children to be due to the pneumococcus. Reference to page 78 shows the portals of entry which we have encountered. Three reports are particularly worthy of mention. In Nattan-Larrier's⁹⁴ case a pneumococcus arthritis of the shoulder followed the infection of an operative harelip wound, the organism being recovered from the pus in the joint and from the wound. In Low's⁸⁰ case a multiple arthritis from which the pneumococcus was recovered was secondary to a primary hemorrhagic ulcerative pneumococcus cystitis. In Cohen's²⁵ case the arthritis

followed a double pyosalpinx with operation followed by umbilical fistula, but unfortunately the bacteriology of the pelvic process was not known. The general statement can be made that the portal of entry is usually one of the mucous membranes associated with the structures connected with the mouth, nose, or pharynx. Hirschberg⁵⁹ has recently reported a series of 43 cases of malignant pneumococcus tonsillitis in which 7 per cent. of the cases developed an arthritis.

That the path of infection from the point of entrance to the joint is usually the blood stream is readily understood when we consider the findings of Rosenow,¹¹⁵ already quoted. We unfortunately did not analyze our cases in regard to lymphatic extension and so can only quote Pfisterer,¹⁰⁴ who found that in 7 cases of unilateral pneumonia, the shoulder-joint in all and the sternoclavicular joint in 3 cases were affected on the same side. Netter⁹⁵ also believes that lymphatic transmission of the infection occurs. We believe with Howard, however, that the blood stream is the usual path of infection.

PATHOLOGY.

One or more joints may be involved, but the majority of cases are monarticular. Of our cases subject to analysis 75 per cent. were monarticular and 25 per cent. polyarticular. The right side (57 per cent.) was involved more frequently than the left (43 per cent.). The lower extremity was implicated far more frequently than the upper, the knee in the lower and the shoulder in the upper extremity being the two joints most often affected. The accompanying table represents in brief form the frequency of involvement of the various joints.

Temporomaxillary	I
Upper extremity	
Sternoclavicular	12
Shoulder	41
Elbow	18
Wrist	22
Metacarpophalangeal	3
Interphalangeal (hand)	I
	97

Lower Extremity		
Hip	23	
Knee	83	
Ankle	20	
Metatarsophalangeal	4	
Small joints of foot (one case).....	1	131
Multiple (4 cases).....		4
		<hr/> 233

Of the single joints affected the knee holds first place, while practically all the monarticular cases have been either the sternoclavicular or one of the large joints. It is interesting to note that not a single case of infection of the acromioclavicular joint or of the vertebral column has been reported, and only one of the temporomaxillary joint.

The process has been suppurative 147 times, serous 15 times, suppurative and serous combined twice, and in 9 cases the data is insufficient. These figures are, however, somewhat misleading for we have encountered many cases in the literature in which the process has evidently been serous, usually in the course of a pneumonia, but in which the joints were not tapped or the fluid was not examined bacteriologically. Such cases we have of course been unable to include. Many of them are possibly examples of the so-called toxic arthritis, but we believe that the majority are cases of septic serous arthritis, pneumococcic in content, often disappearing without treatment and examples of active acquired immunity. We base this belief on the large number of such cases which have been aspirated and in which the pneumococcus has been recovered from the fluid. But even so, the majority of infectious pneumococcus joints are unquestionably suppurative in character.

The conditions found within and about the joints are essentially those of any other septic arthritis. The exudate varies from a serous to a serofibrinous or serosanguinous fluid to the more commonly found thick, creamy, greenish pus. We quote Cave:²¹ "The organism is found in the fluid exudate, either free or embedded in larger cellular elements, and a thin layer of cocci may exist on the free surface of the fibrinous layer

which covers the inflamed synovial membrane. Deeper parts of sections, whether synovial membranes, cartilage, or bone, show as a rule no micro-organisms. The synovial membrane is thickened, irregular, and sections show two layers of about the same thickness: the deeper, vascular and infiltrated with embryonal cells embedded in a meshwork of connective tissue; the superficial consisting of a network of fibrin arranged for the most part parallel to the free surface and containing leucocytes in the interstices. In mild cases or those of short duration the synovial membrane alone may be affected with loss of polish and injection of the fringes. But in many the cartilage is partially or completely eroded and the surface of the bones is laid bare. In the older or more virulent cases the changes are much more destructive, the ligament and cartilage being completely destroyed, as also in some cases the articular ends of the bones. The pus may perforate the capsule and penetrate several inches along the intermuscular planes or sheaths of the tendons." These destructive changes are well illustrated in the cases of Fernet and Lorraine³⁶ in which the joint could scarcely be recognized, and of Picque and Veillon¹⁰⁵ in which the pus burrowed upward from the knee along the femoral artery for six inches and downward between the muscles of the calf. In Slaughter's¹²⁵ case also much extra-articular damage was found. Gasne⁴⁶ believes that in many of the cases in infants not associated with a pneumonia the primary focus is often bony rather than arthritic. He says that in opening these joints we should look carefully for some small focus occurring in one of the bones entering the joint not covered with hyaline cartilage but lying inside the capsule.

SYMPTOMATOLOGY.

The symptoms vary but little from those of any other septic arthritis. No one picture representing the disease in all its various phases can be drawn. Locally there is discomfort which may vary from a mere twinge of pain to pain so excruciating that the slightest touch or motion of the joint may render it well-nigh unbearable. Loss of function invariably

accompanies the pain. Swelling is variable depending on the amount of fluid and whether the capsule is or is not perforated. The joint may not be discolored, the skin over it being normal, but redness and œdema always accompany periarticular involvement. In the chronic cases the skin may be white and show large, dilated veins. Tenderness is, of course, marked, but it is diffuse over the joint, so failing to show localized osseous involvement. The presence of crepitus has not been noted.

The general picture is usually that of a severe toxæmia but many cases are recorded in which the process has been so chronic that a tuberculous or gonorrhœal joint has been suspected. At the other extreme are exceedingly virulent cases in which the picture is that of an acute, overwhelming infection rapidly terminating in death. Such a case is that reported by Pitt ¹⁰⁶ in which the patient died in 48 hours after the onset of the first symptom. The majority of cases fall midway between these two extremes. The temperature is moderate not often rising above 102 to 103°, accompanied by a corresponding increase in the pulse rate. Uncomplicated cases are not excessively sick. In children the general condition seldom keeps pace with the local condition, and a child with a joint full of pneumococcus pus may be bright and eat and sleep well.

In the complicated cases the picture is usually that of severe general sepsis with high fever, rapid pulse, great prostration, chills, and sweats. Such symptoms seldom occur except in the presence of complications and are the result more of the complications than the accompanying arthritis.

COMPLICATIONS.

In 45 per cent. of the cases (78 times) the presence of complications other than pneumonia has been noted, but this figure is probably too low, for many of the reports are incomplete. Briefly tabulated, the complications found were as follows:

Endocarditis	22
Pleurisy and empyema	19
Meningitis	16

Pericarditis	16
Septicæmia	10
Abscess	
Buttock	2
Thigh	4
Arm	2
Parotid	1
Thyroid	1 10
Otitis media	6
Acute nephritis	4
Peritonitis	3
General pyæmia	2
Osteomyelitis	2
Splenic and renal infarcts	1
Septic pulmonary infarct.....	1
Septic thrombus of arm.....	1
Myositis	1
Cellulitis	1
Vaginitis	1
Cystitis	1
Conjunctivitis	1
Decubital gangrene	1

Among the cases reported within recent years many have shown a pure pneumococcus blood culture, but we have been unable to obtain definite statistics on this point.

DIAGNOSIS.

In most cases following pneumonia the diagnosis of pneumococcus arthritis is easy, but because of its rarity (0.14 per cent.) it may be overlooked. Localized articular pain and swelling occurring during or following a pneumonia should not only be presumptive evidence of a pneumococcus arthritis, but should be an indication for immediate exploratory aspiration and bacteriological examination of the fluid by smears, cultures, and animal (mouse or rabbit) inoculation. Only by this means can an accurate diagnosis be reached.

The disease must be differentiated from a number of conditions which it may simulate and which may also be found in connection with a pneumonia. Smirnow,¹²⁶ in examining ten cases of polyarthritis complicating pneumonia, found five in

which the arthritis was due to a streptococcus, staphylococcus, or bacillus typhosus, while Gabbi and Puritz ⁴² and others have reported examples of periarticular localization of the pneumococcus which have closely resembled true articular lesions. Remembering always that the ultimate differentiation must depend on bacteriological examination, there are clinical features which may at times be of service.

Acute suppurative arthritis due to the staphylococcus or one of the various strains of streptococci simulates closely a true pneumococcus arthritis in often occurring after a pneumonia and frequently being monarticular. The constitutional symptoms, however, are apt to be more severe, especially in children, in whom the condition is most apt to be found. Diagnostic aspiration is paramount.

Tuberculous arthritis will rarely cause difficulty, except in the acute fulminating cases which occur in children. Here the use of a tuberculin test will be of assistance. In older individuals the chronic course and constitutional symptoms aid in establishing a diagnosis.

Gonorrhæal arthritis is usually multiple and the original focus of infection can possibly be traced. The complement-fixation test, as first suggested by Müller and Oppenheim,⁹³ may give the necessary clue to the real nature of the condition.

Syphilitic arthritis is rare, of slow onset and of chronic painless course, almost invariably showing a positive Wassermann reaction. This is especially true of the cases of hereditary syphilis occurring in children which are most apt to be confounded with pneumococcus arthritis. The characteristic teeth, facies, and other syphilitic manifestations are also usually present.

Acute rheumatic arthritis is usually multiple, excessively painful, and in children frequently accompanied by endocarditis. The tendency to the involvement of new joints together with the subsidence of those joints first affected is characteristic, while the redness and extreme tenderness are far in excess of that found in pneumococcus arthritis.

In infants under one year of age *scurvy* might be suspected, but close observation will reveal the typical gums of scorbutus and the fact that the pain and swelling are not at the joint but at the epiphysial cartilage.

PROGNOSIS.

The prognosis, always grave, is better when only one joint is affected and complications are absent. Thus in our series, of 66 patients with a monarthrititis and no other focus of infection only 24 per cent. died, while of 98 cases with multiple foci 72 per cent. died, showing conclusively that the danger lies not in the local but rather in the general infection. The prognosis is better in the younger than in the older patients. Among 69 cases below the age of 20 the mortality was 42 per cent., while among 92 cases above that age the mortality was 57 per cent. Herzog gives the mortality among infants as 39 per cent. The mortality rate of our entire series was a trifle over 50 per cent., a figure considerably below the widely quoted 65 per cent. of Herrick.⁵⁶

It is quite possible for general recovery to be followed by local recovery, but statistics on this point are not available. We cannot agree with the statement frequently made that ankylosis of the joint usually results. In only 34 of our case reports is the functional result accurately stated. Of these 25 are described as resulting in good functioning joints, while in many of the reports the impression is given that the patient was left without permanent joint disability.

TREATMENT.

In addition to such general measures as may be indicated, there are a number of methods of local treatment which present themselves. Palliative and temporizing methods cannot be too strongly condemned. Of 19 cases in which such means were used 17 died, a mortality of 89 per cent.!

Radical treatment should be undertaken not only as soon as a diagnosis is made but if necessary should be utilized in arriving at such diagnosis. The four surgical means at our dis-

posals in the order of their severity are aspiration, arthrotomy, resection, and amputation. Briefly tabulated the results in this series of these methods of treatment were as follows:

	Number of Cases.	Recovered.	Died.	Mortality.
Aspiration	21	13	8	38 per cent.
Arthrotomy	91	59	32	35 per cent.
Resection	1	1	0	0 per cent.
Amputation	3	1	2	66 per cent.

These figures are probably somewhat misleading, for the severity of infection and the type of arthritis are not shown by numerals. Very few, if any, cases of true suppurative arthritis in which aspiration alone was done recovered. This form of treatment should be primarily diagnostic. If the fluid obtained is clear or only very slightly turbid, the aspiration should be again repeated as often as necessary. If, on the other hand, pus is obtained either by the first or by subsequent aspirations, an arthrotomy should be immediately performed. Considering the fact that the arthritis is usually only one manifestation of a general bacteriæmia, it is a question whether resection or amputation are often advisable except for correction of the resulting deformity.

And finally just a word on active and passive immunity in their relation to possible treatment. In one case arthrotomy was supplemented by autogenous vaccines, and in another case autogenous vaccines were alone employed. Both cases recovered, and while the number is insufficient for definite conclusions, they may point the way for future results possibly better than those of the past. The recent work of Wadsworth¹³⁶ in the treatment of pneumococcus infections in animals by immune sera is also encouraging. So far as we know the method has not yet been tried on man, but we would not hesitate to attempt it on our next case. The present mortality rate certainly cannot fail to inspire one to discover and use all means possible to achieve better results.

The writer desires to express his appreciation of the kindness of Dr. Joseph A. Blake in allowing him to operate upon and report this case.

CHRONOLOGIC TABLE OF REPORTED CASES OF PNEUMOCOCCIC ARTHRITIS.

No.	Reporter	Date	Age	Sex	Seat of arthritis	Relation of pneumonia	Nature	Complications	Treatment of joint	Functional result	Recovery or death	Remarks
1	Weichselbaum ¹⁷	1888	54	..	Rt. shoulder	Pn. 3 days before	Suppurative	.....	?	.....	D.	
2	Belfanti ⁸	1889	...	..	Rt. wrist	Pn. 11 days before	Suppurative	.....	?	.....	D.	
3	Monti ¹⁹	1889	...	..	Metacarpophalangeal	Pneumonia	?	.....	?	.....	D.	
4	Popescu ¹⁰⁷	1889	60	M	Rt. knee	Pn. 4 months before	Suppurative	Ulcerative endocarditis. Septic pulmonary infarct	?	.....	D.	Knee injured 2 weeks prior to pneumonia.
5	Lanndongue ¹¹² and Achard	1890	19 mo.	M	Rt. hip	None	Suppurative	Marasmus	Arthrotomy	.....	D.	
6	Ortman and Samter ¹¹³	1890	34	M	Shoulder	Pn. few days before	Suppurative	.....	Arthrotomy	.....	R.	
7	Boulloches	1891	5	M	Both elbows and rt. knee	Pn. 5 days after	Suppurative	Acute myositis. Acute nephritis	O	.....	D.	Secondary to throat.
8	Chantemesse ⁸	1891	A	..	Elbow and knee	Pn. crisis 2 days before	Serous	Meningitis	?	.....	D.	
9	Macaigne and Chipault ¹¹⁴	1891	60	F	Rt. knee	Pn. 4 days before	Suppurative	.....	Arthrotomy	.....	R.	
10	Picque and Veillon ¹¹⁵	1891	36	M	Rt. knee	Pn. 4 days before	Suppurative	.....	Arthrotomy	.....	D.	
11	Brunner ¹⁸	1892	52	M	Left wrist	Pn. 2 days before	Suppurative	.....	Arthrotomy	.....	D.	
12	Juvigny ¹⁰⁸	1894	52	M	Both knees. Ankle	Pneumonia	Suppurative	.....	Arthrotomy	.....	D.	
13	Meunier ¹⁰⁹	1894	60	M	Rt. knee	Pn. 4 days before	Suppurative	Septicemia	Aspiration, arthrotomy	.....	?	Left hospital against advice.
14	Sittman ¹¹⁶	1894	40	M	Left shoulder	Pneumonia	Suppurative	Peri- and endocarditis	O	.....	D.	
15	Dominici ¹⁰⁹	1895	44	M	Rt. shoulder	Pn. 12 days before	Suppurative	Meningitis, lead poisoning. Pericarditis and endocarditis	Arthrotomy	.....	D.	
16	Kasperek ¹⁰⁷	1895	...	M	Left metatarsophalangeal	None	Suppurative	Pericarditis, gout, chronic lead poisoning	?	.....	D.	Chronic lead poisoning; crystals of sodium urate in articular cartilage.
17	Assiet ¹¹	1896	41	M	Both knees	Pn. 7 days before	Suppurative	.....	?	.....	D.	Rheumatism two years previously.

* Quoted from case. Original not found.

18.	Fernet and Lorraine ⁸	1866	56	M L. sternoclavicular; rt. shoulder	?	Suppurative	.....	?	Shoulder recovered before death	D.	Extreme destruction of joint.
19	Griffon ⁸¹	1866	71	F Rt. ankle	?	Suppurative	Suppurative metritis; hemiplegia, acute endocarditis	Arthrotomy	.....	D.	
20	Mercantonio ⁸¹	1866	71	M Rt. shoulder	Pn. few days before	Suppurative	.....	Arthrotomy	.....	D.	
21	Nicolaysen ⁸⁶	1866	3 wk.	M Rt. elbow	Pn. 8 days before	Suppurative	Endocarditis. Bilateral empyema	O	.....	D.	
22	Schababi ¹⁸	1866	45	M L. knee and hip	Pneumonia	Suppurative	.....	?	.....	D.	
23	Vogelius ⁴¹	1866	38	M Rt. sternoclavicular	Pn. 5 days before	Suppurative	.....	Arthrotomy	.....	R.	
24	Vogelius ⁴¹	1866	60	M Hip	Pn. some days before	Suppurative	Lead poisoning, empyema endocarditis	Arthrotomy	.....	D.	
25	Widal ¹⁰⁹	1896	A	M Metatarsophalangeal	None	Suppurative	Suppurative pericarditis; lead poisoning; gout	O	.....	D.	Crystals of sodium urate in joint.
26	Widal and Meslay ¹¹¹	1896	A	M Metatarsophalangeal	None	Suppurative	Suppurative pericarditis	O	.....	D.	Crystals of sodium urate in joint. Worker in lead.
27	Duffocq and Ledamant ¹¹²	1897	32	M L. phalangeal; both elbows	Pn. 9 days before	Suppurative	.....	?	.....	D.	Old rheumatoid arthritis
28	Heubner ¹¹³	1897	5 mo.	.. L. shoulder	Pn. 4 weeks before	Suppurative	.....	Arthrotomy	.....	R.	
29	Lexer ⁷⁷	1897	5 mo.	.. Knee	None	Suppurative	.....	Arthrotomy	.....	R.	
30	Lexer ⁷⁷	1897	9 mo.	.. Shoulder	None	Suppurative	.....	Arthrotomy	.....	R.	
31	Lexer ⁷⁷	1897	1 yr.	.. Knee and hip	Pn. 9 weeks before	Suppurative	Abscess of thigh	Arthrotomy	.....	R.	
32	Muhsam ¹¹	1897	55	M Rt. shoulder	Pn. 29 days before	Suppurative	.....	Arthrotomy	.....	R.	Alcoholic joint disintegrated.
33	Tournier and Courmont ¹¹⁰	1897	50	M L. knee and shoulder	Pn. 6 days before	Suppurative	Empyema. Secondary syphilis	Arthrotomy	.....	D.	
34	Widal and Mercier ¹¹¹	1897	46	M Wrist and ankle	Pn. 4 days before	Suppurative	Endocarditis	?	.....	D.	Typhoid arthritis 25 years before.
35	Boix ¹¹⁴	1898	A	M Rt. knee	Pneumonia	Suppurative	General pyemia	Repeated aspirations	.....	D.	
36	Flament ¹¹³	1898	53	M Rt. knee	Followed pneumonia	Suppurative	.....	Resection	.....	R.	Chronic rheumatism and old injury of knee.
37	Gagnon ¹¹³	1898	8 mo.	F Knee	None	Suppurative	Purulent conjunctivitis	Arthrotomy	.....	R.	Secondary to conjunctivitis.
38	Gallard and Morely ¹¹⁵	1898	44	M Rt. wrist	Pn. 9 days before	Suppurative	.....	Arthrotomy	.....	R.	
39	Hagenbach and Burckhardt ¹¹³	1898	2½	F Shoulder and rt. knee	None	Suppurative	Abscess of arm; abscess of thigh	Arthrotomy	.....	R.	Secondary to abscess of thigh.

CHRONOLOGIC TABLE OF REPORTED CASES OF PNEUMOCOCCIC ARTHRITIS.—Continued.

No.	Reporter	Date	Age	Sex	Seat of arthritis	Relation of pneumonia	Nature	Complications	Treatment of joint	Functional result	Recovery or death	Remarks
40	McDonald ¹⁰	1898	15	M	Hip	None	Suppurative	General sepsis	Arthrotomy	.....	D.	Suppurative joint following injury.
41	Osler ⁴⁹	1898	24	M	Knee	Pneumonia	Suppurative	Meningitis and double pneumo- nia; septicemia	Arthrotomy	.....	D.	
42	Petit ¹⁰³	1898	42	M	L. knee	Pn. 5 days before	Suppurative	Meningitis	Arthrotomy	.....	D.	
43	Uckmar ¹¹²	1898	A	M	Rt. shoulder	Pn. crisis 5 days before	Suppurative	.....	Aspiration and arthrotomy	Perfect	R.	
44	Widal and Les- nig ¹⁰⁴	1898	68	M	L. sternoclavicular	None	Suppurative	.....	Repeated aspirations	.....	R.	Chronic rheumatic.
45	Leroux ¹¹	1899	45	M	L. wrist	Pn. 9 days before	Suppurative	Endocarditis; peritonitis; pleurisy; meningitis	? ?	.....	D.	
46	Preble ¹⁰⁸	1899	43	F	Knee, ankle, wrist and elbows	None	Suppurative	Suppurative meningitis, general pneumococcus, bacteremia	? ?	.....	D.	
47	Preble ¹⁰⁸	1899	33	M	Knee, elbow, wrist, 2nd metacarpophalangeal	Pneumonia	? ?	.....	? ?	.....	D.	
48	Sorel ¹¹⁷	1899	48	M	L. shoulder	Pn. 8 days before	Suppurative	Empyema	? ?	.....	D.	Injured left shoulder and knee one day before onset of arthritis. Old rheumatic.
49	Billings ¹¹	1900	23	M	Rt. shoulder, left knee, metatarsophalangeal	Pneumonia	Suppurative	.....	O	.....	D.	
50	Fernet and Lacap ¹⁰⁵	1900	47	M	Rt. wrist	Pn. 3 days before	Serous	.....	? ?	Stiff joint	R.	
51	Lop and Bonus ¹¹⁶	1900	28	F	Rt. wrist	Pn. 8 days later	Suppurative	Peritonitis; suppurative parotitis	Arthrotomy	.....	R.	Followed labor and peritonitis. Pneumococci in vaginal discharge.
52	Rendu ¹¹¹	1900	66	M	L. knee, 1. sternoclavicular	Pn. 15 days before	Serous and suppurative	.....	Arthrotomy	.....	R.	

53	Agathos ²	1901	60	M	L. sternoclavicular	Pneumonia	Suppurative	.....	Arthrotomy	.....	R.
54	Agathos ²	1901	63	M	L. wrist	Pn. 10 days before	Suppurative	Empyema, pericarditis	Arthrotomy	.....	R.
55	Allen and Lull ³	1901	40	F	L. knee	None	Suppurative	.....	Arthrotomy	.....	D.
56	Anzilotti ⁴	1901	50	M	L. knee	Pneumonia	Suppurative	Acute nephritis, decubital gangrene	Arthrotomy, amputation	.....	D.
57	Cave ²	1901	51	M	L. shoulder	Pn. 9 days before	Suppurative	.....	O	.....	D.
58	Lannois and Pica ⁵	1901	46	M	Rt. wrist	Followed pn.	?	Endocarditis	?	.....	D.
59	Rawu	1901	28	M	Rt. sternoclavicular	Pn. 3 days before	Suppurative	Rt. otitis media; abscess of thigh	Arthrotomy	.....	R.
60	Rawu	1901	52	M	Rt. ankle	Pn. 2 days before	Suppurative	Rt. empyema	Arthrotomy	Stiff joint	R.
61	Rawu	1901	49	F	Rt. shoulder	Pn. 2 days before	Suppurative	Rt. empyema; cellulitis	Arthrotomy	.....	D.
62	Rawu	1901	23	M	Rt. knee	Pn. 2 days before	Serous	.....	Aspiration	U s e f u l joint	R.
63	Rawu	1901	51	M	Both knees	Pn. 6 days before	Serous	Severe toxæmia; generalized infection	Aspiration	.....	D.
64	Rawu	1901	58	M	Rt. knee	Pn. 3 days before	Suppurative	Arthrotomy	Arthrotomy	Stiff joint, but useful	R.
65	Rawu	1901	42	M	Rt. shoulder	Pneumonia	Suppurative	Severe general infection	O	.....	D.
66	Barnard ⁶	1902	14	M	Rt. knee	None	Suppurative	.....	Arthrotomy	.....	R.
67	Bichat and Goeptert ⁷	1902	8 mo.	F	Rt. knee	Broncho-pn.	Suppurative	.....	Arthrotomy	Perfect	R.
68	Bichat and Goeptert ⁷	1902	11 mo.	F	Rt. knee	Broncho-pn.	Suppurative	Meningitis	Exploratory puncture	.....	?
69	Cole ⁸	1902	50	M	Ankle	Pn. 12 days before	Suppurative	Endocarditis	Aspiration, arthrotomy	.....	R.
70	Cole ⁸	1902	55	M	Both knees and ankles	Pn. later	Suppurative	Septicæmia and meningitis	.....	.....	R.
71	Gallard ⁴⁴	1902	63	M	Rt. knee	Pneumonia	Suppurative	Endocarditis	Aspiration, arthrotomy	.....	D.
72	Gallard ⁴⁵	1902	31	M	Rt. knee	Pneumonia	Suppurative	In extremis	Aspiration, amputation	.....	D.
73	Hektoen ⁴⁵	1902	47	M	L. knee	Pneumonia	Suppurative	.....	Aspiration	Free motion	D.
74	Herrick ⁴⁶	1902	32	M	L. elbow	Pn. 7 days before	Suppurative	.....	?	U s e f u l knee	R.
75	Herrick ⁴⁶	1902	41	M	L. knee	Pn. 2 weeks before	Serous	Dry pericarditis	Repeated aspirations	.....	R.
76	Herrick ⁴⁶	1902	26	M	Rt. knee	Pn. crisis 8 days before	Suppurative	Pericarditis. Severe toxæmia	Arthrotomy	.....	D.

Alcoholic. Injured knee one month previously.

Left hospital against advice.

Leucocytes 15,000.

Old arthritis deformans.

Chronic alcoholic.

Alcoholic.

Alcoholic.

CHRONOLOGIC TABLE OF REPORTED CASES OF PNEUMOCOCCIC ARTHRITIS.—Continued.

No.	Reporter	Date	Age	Sex	Seat of arthritis	Relation of pneumonia	Nature	Complications	Treatment of joint	Functional result	Recovery or death	Remarks
77	Miller ¹⁴	1902	A	M	Rt. wrist	Followed pn.	Serous	.....	O	Stiff joint	R	
78	Pfisterer ¹⁰⁴	1902	8 mo.	F	Both wrists and left knee	Broncho-pn.	Suppurative	Double otitis media; suppurative meningitis; nephritis	?	.....	D.	
79	Pfisterer ¹⁰⁴	1902	13 mo.	M	Hip	Pn. 10 days before	Suppurative	.....	Arthrotomy	.....	R.	
80	Quincy ¹⁰	1902	30	F	Rt. sternoclavicular	Pn. 7 days before	Suppurative	Endocarditis, nephritis	Arthrotomy	.....	D.	Old rheumatism.
81	Siredey and Coudert ¹²³	1902	25	F	Metacarpophalangeal	Pneumonia	Suppurative	Pericarditis	?	.....	D.	
82	Spittatz ¹²⁸	1902	17 mo.	F	L. elbow	Pn. 10 days before	Suppurative	Empyema, meningitis	Aspirations	.....	D.	
83	Wells ¹³⁸	1902	32	F	L. sternoclavicular	Pn. 9 days before	Suppurative	.....	Arthrotomy	.....	R.	
84	Dudgeon and Branson ³⁰	1903	5 mo.	F	L. knee	None	Suppurative	Bronchitis	Arthrotomy	.....	D.	
85	Dudgeon and Branson ³⁰	1903	6	M	L. knee, r. hip and wrist	None	Suppurative	Asthenia	Arthrotomy	.....	D.	Secondary to otitis media.
86	Dudgeon and Branson ³⁰	1903	6 mo.	F	Knee, interphalangeal (hand)	None	Suppurative	.....	Arthrotomy	.....	D.	
87	Dudgeon and Branson ³⁰	1903	14 mo.	M	Rt. elbow	Pn. 2 weeks before	Suppurative	.....	Arthrotomy	.....	R.	
88	Dudgeon and Branson ³⁰	1903	21 mo.	F	Rt. hip	None	Suppurative	.....	Arthrotomy	Dislocated joint	R.	Secondary to measles.
89	Finkelstein	1903	13	M	Hip	None	Suppurative	Suppurative meningitis	Aspirated	.....	D.	
90	Howard ⁴¹	1903	42	M	Rt. shoulder, rt. ankle	Pn. 7 days before	Suppurative	Pericarditis, endocarditis, meningitis	O	.....	D.	
91	Howard ⁴¹	1903	79	M	Both knees, l. shoulder	Pn. 7 days before	Suppurative	Meningitis	O	.....	D.	
92	Howard ⁴¹	1903	69	F	Knee	Pn. 10 days before	Suppurative	Acute endocarditis	O	.....	D.	
93	Meyer ⁴⁶	1903	21 mo.	M	L. ankle	None	Suppurative	.....	Arthrotomy	.....	R.	Secondary to varicella.

94	Meyer ²⁸	1903	16 mo.	F	R. shoulder	None	Suppurative	.....	Aspiration	.....	R.
95	Meyer ²⁸	1903	36	F	L. shoulder and l. hip	Pneumonia	Suppurative	.....	Arthrotomy	.....	R.
96	Pachioni ¹⁰⁰	1903	2½	F	Both hips, l. shoulder	Pn. 3 weeks before	?	Pneumococcus vaginitis	Aspiration	.....	R.
97	Raw ¹²	1903	41	F	L. temporomaxillary	Pneumonia	Suppurative	Double empyema	Arthrotomy	.....	R.
98	Salmon ¹⁷	1903	2½	..	Large joints	None	Suppurative	Congenital lues	.....	.....	D. Primary case.
99	Schuster ¹⁹	1903	A	M	Rt. elbow	Pn. 20 years before	Suppurative	Malignant endocarditis	Arthrotomy	.....	D.
100	Simonini	1903	3 mo.	F	Rt. knee, small joints of foot	Pn. 4 days before	Suppurative	.....	Arthrotomy	.....	D. Pneumococcus in urine.
101	Simonini	1903	9	F	Wrist, ankle, knee, shoulder	None	Serous and suppurative	.....	Aspiration, arthrotomy	Function limited	R. Pneumococcus in urine secondary to pharynx and tonsils.
102	Simonini ¹²²	1903	4½	F	Rt. wrist, l. elbow	Pn. 6 days before	Suppurative	.....	Aspiration	Function perfect	R. Pneumococcus in urine.
103	Slaughter ¹²³	1903	15	M	Rt. knee	Pn. 2 weeks before	Suppurative	Tuberculous right knee	Arthrotomy, amputation	.....	R. Pneumococcus infection of tuberculous joint.
104	Tubby ¹²²	1903	14 wk.	M	Rt. knee	None	Suppurative	.....	Arthrotomy	.....	R. Primary case.
105	Brunn ¹⁷	1904	11	F	Rt. knee	None	Suppurative	.....	Arthrotomy	.....	R. Primary case.
106	Brunn ¹⁷	1904	16	F	Rt. knee	None	Suppurative	Acute osteomyelitis	Arthrotomy	.....	R. Primary case.
107	Cabanes ¹⁹	1904	22 d.	M	L. ankle, knee and shoulder	None	Suppurative	.....	Arthrotomy	.....	R. Secondary to suppurative at umbilicus.
108	Ciechomski ¹²⁴	1904	5½	F	Rt. wrist and hip	None	Suppurative	.....	Arthrotomy	.....	R. Secondary to otitis and co-ryza.
109	Davis and Brown ¹³	1904	8	F	Rt. knee	Pn. 1 day before	Suppurative	Empyema, suppurative peritonitis	Arthrotomy	Ankylosis	R.
110	Davis and Brown ¹³	1904	13	F	Rt. sternoclavicular and wrist	None	Suppurative	Splenic and renal infarcts, pericarditis	?	.....	D. Secondary to otitis media.
111	Goldthwait ⁶	1904	5	..	Shoulder	?	Suppurative	.....	Arthrotomy	Fair function	R.
112	Krokiewicz ²⁰	1904	28	M	Shoulder	Pn. 6 days before	Suppurative	.....	Arthrotomy	.....	D.
113	Segrán	1904	18	M	Rt. foot, left shoulder	None	Suppurative	.....	Arthrotomy	.....	R. Followed injury to joint from fall.
114	Segrán	1904	51	M	Knee	None	Suppurative	.....	Arthrotomy	.....	R. Old rheumatic.
115	Cohen ¹³	1905	30	F	Ankle	None	Suppurative	.....	Arthrotomy	.....	R. Followed pyosalpinx and umbilical fistula.

CHRONOLOGIC TABLE OF REPORTED CASES OF PNEUMOCOCCIC ARTHRITIS.—Continued.

No.	Reporter	Date	Age	Sex	Seat of arthritis	Relation of pneumonia	Nature	Complications	Treatment of joint	Functional result	Recovery or death	Remarks
116	Ely ³³	1905	4	M	L. hip	Pn. 9 days before	Suppurative	Suppurative pleurisy	Aspiration, arthrotomy	.....	D.	Leucocytes 24,400. Head of bone eroded.
117	Ponca ⁴⁰	1905	28	F	Rt. knee	None	Suppurative	.....	Repeated aspirations	.....	R.	Probably secondary to throat infection.
118	Nattan-Larrier ⁴¹	1905	Inf't	M	Rt. shoulder	None	Suppurative	.....	O	.....	D.	Followed operation for hare-lip. Pure pneumococcus culture from both joint and hip wound.
119	Rossi ⁴⁶	1905	30	M	Multiple	Pn. 4 days later	Serous	.....	O	.....	R.	
120	Witt ⁴⁵	1905	36	M	Rt. knee	Pn. 17 days before	Suppurative	Empyema; septic thrombus; rt. arm	Aspirated	.....	D.	
121	Berghinz ⁴⁹	1906	11 days	..	L. sternoclavicular; rt. hip	Broncho-pn.	Suppurative	Suppurative pleurisy	?	.....	D.	
122	Chatterji ⁵³	1906	28	M	Rt. knee	Pn. 6 days before	Suppurative	.....	Arthrotomy	Partial stiff joint	R.	
123	Chatterji ⁵³	1906	40	M	Rt. knee	Pn. 4 days before	Suppurative	.....	Aspiration	.....	?	Left hospital against advice.
124	Chatterji ⁵³	1906	57	M	L. shoulder	Pneumonia	Suppurative	.....	Arthrotomy	Ankylosis	R.	Necrosis of bone; leucocytes 125,000-150,000.
125	Ghedini ⁴⁷	1906	50	M	L. sternoclavicular	Pn. few days before	Suppurative	.....	Arthrotomy	.....	R.	
126	Greathould ⁵⁹	1906	4	M	Rt. knee	After pn.	Suppurative	.....	Arthrotomy	.....	R.	Primary.
127	Herzog ⁶⁷	1906	9	M	Wrists	None	Serous	Septicemia	?	.....	D.	Primary. Pneumonia a terminal event.
128	Herzog ⁶⁷	1906	5 mo.	F	Both shoulders; l. knee	Broncho-pn.	Suppurative	.....	Arthrotomy	.....	D.	
129	Herzog ⁶⁷	1906	1	F	L. hip	Broncho-pn.	Suppurative	Rickets	Arthrotomy	Good function	R.	
130	Herzog ⁶⁷	1906	3 mo.	F	Rt. hip	Pn. 3 weeks before	Suppurative	.....	Arthrotomy	Good function	R.	
131	Howard ⁶²	1906	..	..	Rt. shoulder and l. ankle	?	Suppurative	Peri- and endocarditis	?	.....	D.	
132	McClannon ⁶⁷	1906	35	M	Rt. ankle	Pn. 7 days before	Suppurative	.....	Arthrotomy	Movable joint	R.	

133	Middletown ⁹⁰	1906	31	M	L. knee	Pn. 7 days before	Suppurative	.....	Aspirated	.....	D.	
134	Pasteur and Courtauld ⁹⁴	1906	23	M	Rt. knee	None	Suppurative	.....	Aspiration, arthrotomy ?	Good function	R.	Previous injury to joint. Primary case.
135	Pitt ⁹⁶	1906	17	M	Multiple	?	?	General bacteremia severe	Arthrotomy	.....	D.	Unusually rapid. Death 48 hrs. after onset of symptoms.
136	Raw ⁹³	1906	40	M	Rt. knee	Pn. crisis 1 day before	?	.....	Arthrotomy	.....	D.	Markedly alcoholic.
137	Secretan and Wrangham ¹⁰⁰	1906	16	M	Rt. knee	Pn. 5 days before	Suppurative	.....	Arthrotomy	Perfect function	R.	
138	Bassenge ⁹⁷	1907	56	M	Knee	Pn. 2 weeks before	Suppurative	Pleurisy and pericarditis	Aspiration	.....	D.	Chronic alcoholic.
139	Carmichael ⁹⁸	1907	6 w.k.	F	Hip and wrist	None	Suppurative	.....	Arthrotomy	.....	R.	
140	Coutts ⁹⁷	1907	2	F	Rt. shoulder and l. hip	Pneumonia	Suppurative	Suppurative osteitis of rib	Arthrotomy	.....	D.	
141	Furze ⁹¹	1907	16 mo.	M	Rt. elbow	Pn. 6 months later	Suppurative	.....	Arthrotomy	.....	D.	Should be classed as a recovery, as pneumonia and liver abscess developed 6 months later.
142	Nitch ⁹⁷	1907	1	F	L. knee	None	Suppurative	Otitis media, bronchitis	Aspiration, arthrotomy	Perfect function	R.	Secondary to bronchitis.
143	Nitch ⁹⁷	1907	6 mo.	F	Rt. knee	None	Suppurative	Otitis media	Aspiration, arthrotomy	.....	D.	Secondary to otitis media.
144	Pender ¹⁰²	1907	70	F	L. knee	?	?	.....	Arthrotomy	.....	R.	
145	Von Khaut ²¹³⁵	1907	52	F	Rt. knee	Pneumonia	Serous	.....	Aspiration	Good function	R.	Rheumatism 6 years before.
146	Von Khaut ²¹³⁵	1907	2	M	Rt. knee	Pn. 14 days before	Suppurative	Rickets	Arthrotomy	Good function	R.	
147	Bell ⁹	1908	22	M	Rt. sternoclavicular	?	Suppurative	General bacteremia	Arthrotomy	.....	D.	
148	Eyre ³⁴	1908	C	F	Hip	Pneumonia	Suppurative	Abscess of arm, empyema	Arthrotomy and autogenous vaccine	.....	R.	
149	Gasne ⁴⁶	1908	4	M	Both ankles, l. knee	Pn. 15 days before	Suppurative	.....	Multiple arthrotomy	Good function	R.	
150	Gasne ⁴⁶	1908	3	F	L. shoulder	None	Serous	Rickets	Aspiration	Good function	R.	
151	Gasne ⁴⁶	1908	1	F	Rt. knee	None	Suppurative	.....	Arthrotomy	Good function	R.	
152	Gasne ⁴⁶	1908	25 d.	M	L. knee	None	Suppurative	Pneumococcus peritonitis and meningitis	Arthrotomy	.....	D.	
153	Hand and Jonson ⁵⁴	1908	46	M	Knee	Pn. 14 days before	Suppurative	.....	Aspiration, arthrotomy	Perfect function	R.	Injury to knee. Very alcoholic.
154	Holt ⁴⁰	1908	Inf't	F	Shoulder	After pn.	Suppurative	.....	Aspiration	.....	?
155	Kirrmisson ⁶³	1908	4	F	Rt. shoulder	?	Suppurative	Rickets	Arthrotomy	.....	R.	
156	Kirrmisson ⁶³	1908	14 mo.	M	Rt. knee	?	Suppurative	.....	Arthrotomy	.....	R.	

CHRONOLOGIC TABLE OF REPORTED CASES OF PNEUMOCOCCIC ARTHRITIS.—Continued.

No.	Reporter	Date	Age	Sex	Seat of arthritis	Relation of pneumonia	Nature	Complications	Treatment of joint	Functional result	Recovery or death	Remarks
157	Low ⁸	1908	A	M	Multiple	None	Serous	Pneumococcus cystitis	Autogenous vaccine	Good function	R.	Secondary to pneumococcus cystitis.
158	Matthews ⁸⁸	1908	34	M	Rt. shoulder	Pn. 9 days before	Suppurative	Acute endocarditis	Arthrotomy	.....	D.	
159	LaPetra ⁷¹	1909	8 mo.	F	Knee	Pn. 7 weeks before	Suppurative	Meningitis	Arthrotomy	.....	D.	
160	Letulle and Leconte ¹⁸	1909	41	M	L. ankle	Pneumonia	Suppurative	Suppurative thyroiditis; multiple abscess	Arthrotomy	.....	R.	Very alcoholic.
161	Strickler ¹²⁹	1909	25	F	Knee	?	Serous	.....	Aspiration	Partial still joint	R.	
162	Adenot ¹	1910	41	M	Rt. knee	Pn. 14 days before	Suppurative	.....	Aspiration	Fairly useful joint	R.	Old syphilis.
163	Jaboulay ⁶⁴	1910	A	M	Elbow	Pneumonia	Suppurative	Pneumococcus abscess of buttock and calf of leg	?	.....	?	Secondary to trauma
164	Koplik ⁴⁹	1910	Inf't	F	?	Broncho-pn. Pn. 11 days before	Suppurative	.....	?	.....	?	Congenital syphilis.
165	Leclerc and Favre ⁷⁴	1910	32	F	Rt. elbow	None	Suppurative	.....	O	.....	D.	
166	MacCordick ⁸²	1910	16	F	L. shoulder	None	Suppurative	Pericarditis, endocarditis	O	.....	D.	Old rheumatism.
167	MacCordick ⁸²	1910	16	F	L. ankle	Pn. few days after	Serous	Pericarditis, pleurisy, endocarditis	O	.....	D.	Old rheumatic.
168	MacCordick ⁸²	1910	13	F	L. shoulder	Pn. 6 days before	Serous	Pleurisy	O	.....	D.	Previous rheumatism.
169	MacCordick ⁸²	1910	14	F	Both knees	None	Serous	Endocarditis	O	.....	D.	
170	Trevisanello ¹⁰¹	1911	A	M	Left knee	Pn. 9 days before	Suppurative	.....	Aspiration	.....	?
171	Edberg ²²	1913	3 wk.	F	Rt. hip	None	Suppurative	Abscess of gluteal region	Arthrotomy	Joint deformity	R.	Secondary to gastro-enteritis.
172	Edberg ²²	1913	2 mo.	F	Both hips	None	Suppurative	.....	Arthrotomy	.....	R.	Secondary to ileocolitis.
173	Bulkley	1913	11 mo.	F	Rt. shoulder	Pn. 2 weeks before	Suppurative	Aspiration, arthrotomy	Perfect function	R.	

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THE USE OF CITRATE SOLUTIONS IN THE PREVENTION OF PERITONEAL ADHESIONS.*

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A BETTER title for this paper would be: An experimental study in the prevention of peritoneal adhesions, working upon the hypothesis that fibrous exudates in the peritoneal cavity depend upon the same principles that apply to the formation of fibrin in blood clots; *i.e.*, before a fibrous exudate can form in the peritoneal cavity with its resultant plastic agglutination, there must be the liberation of that hypothetical ferment, thrombokinase, its activation of prothrombin in the presence of calcium and the production of thrombin.

Thrombin as an active enzyme converts soluble fibrinogen into fibrin.

If then, we are to attempt to influence the production of fibrin deposits or peritoneal adhesions in the abdominal cavity, we must by some method inhibit the process of ferment activity. We must either inactivate thrombokinase or bind the calcium in the serous exudate.

In the Research Laboratory of the Medical Department of the University of California I have done a series of some sixty experiments on rabbits (these animals have all been under ether narcosis).

To determine first, whether or not there was an active thrombin element in the normal peritoneum, a rabbit was carefully opened, the peritoneum gently everted, covering the edges of the abdominal incision. An artery in the flank was cut and allowed to bleed freely into the abdominal cavity. Clotting occurred at the site of bleeding in 5 minutes, which is about the normal time for rabbits. Blood, running over the surface of this clot and gravitating to the region about the kidney where neither air had entered nor any trauma had been inflicted, remained fluid and unclotted for 15 minutes.

* Read before the California Academy of Medicine, May 26, 1913.

Rabbit No. 2 was similarly opened, the peritoneum roughly scrubbed with a gauze sponge, a mesenteric vessel cut and allowed to bleed. Clotting occurred in 3 minutes.

Rabbit No. 3 was opened, the contents of the ileum and jejunum smeared over the intestines and an artery in the mesentery severed. Blood flowing outside the peritoneal cavity clotted in four minutes, while blood in the soiled peritoneum was mainly fluid at the end of 15 minutes.

These findings are paralleled by clinical experience. It is a common phenomenon to observe that during abdominal operations, where the peritoneum is abraded and traumatized extensively, there is an abundant formation of clots. While after intra-abdominal wounds which cause little trauma, but sever large blood-vessels, the abdomen may be found filled with fluid blood. It is also no uncommon thing to find laked, unclotted blood where the intestinal or gastric contents have escaped into the abdominal cavity following perforating or lacerating wounds of these viscera.

From this evidence we may assume first of all that there is not an active thrombin element in the normal, untraumatized peritoneal cavity. Second, that trauma to the endothelium of the peritoneum, even exposure to the air, causes the liberation of an active thrombin ferment, supposedly thrombokinase. Third, that the presence of intestinal or gastric juice with its ferments retards or abolishes the action of thrombokinase.

It is, of course, a fact that pepsin, trypsin and other powerful enzymes will inactivate thrombokinase. It is also a physiologic law that thrombokinase only is active in the presence of a calcium salt. And this salt may be bound or neutralized by citrates, oxalates or sulphates.

These experiments have been conducted to ascertain if this hypothesis in any way helped to elucidate the problem of peritoneal exudates, and the production or prevention of peritoneal adhesions. Heretofore, apparently all our preventive measures have assumed the rôle of lubricants or protectives, as if the abdominal organs were a collection of lead pipes, pistons, filters and valves,—a purely mechanical conception.

In this work, therefore, the direct experimental method,

the empirical testing of measures only vaguely suggestive, and the control, or comparative measures, have been combined. Because our interest is mainly centred in that phase of peritoneal adhesions found in the surgical problems of the abdomen, I have applied my endeavors to the prevention, if possible, of post-operative adhesions.

To mimic those conditions which most surely are productive of strong fibrous adhesions, the colon of the rabbit was scarified throughout its length with multiple scratches about an inch long, possibly four or five hundred in number. These were deep enough to cause oozing of blood, to expose the muscularis, but avoided active bleeding and puncture.

In control rabbits at the end of a week an abdomen thus treated is a mass of agglutinated intestine, hemorrhagic exudate, fibrous lymph and many plastic adhesions. In order to tabulate the results of these various experiments two general headings have been made, designated as exudate and adhesions, and their degree marked by the plus or minus sign. In some instances a quantitative estimation of the albumin output was made and recorded. This was done by implanting little glass tubes in the abdominal cavity and at the end of a week estimating by means of phosphotungstic acid, the albumin content. It was hoped by this device to be able to gauge the relative inflammatory reaction present. But the method was found too uncertain to warrant putting any confidence in it.

The following tabulation shows the average result of repeated experiments. The variations in these repetitions were so small that no indecision arose over the markings. In each case the scarification of the colon was followed by pouring into the abdominal cavity one-half ounce of the sterilized solution in question. The incisions were closed with silk.

In this series of exudates none presented a worse appearance than the experiment with camphorated oil. Here there is a thick creamy deposit, masses of fibrous lymph, large plaques of camphor adherent to the mural peritoneum and under the diaphragm, and dense resistant adhesions throughout the entire abdomen.

TABLE I.

	Exudate.	Adhesions.
Control	+	++
Tr. Iodine	++	++
Camphorated oil	+++	+++
Olive oil	++	++
Petrolatum	++	++
Butter	++	++
Sugar 50 per cent. solution	+	++
Citrated sugar	+	+
Egg albumen	+	+
Citrated egg albumen	++	+
Milk	+	+
Peptonized milk	+	—
Ringer's solution	—	++
Salt solution, normal	—	+
Ammonium oxalate 1 per cent. } Salt solution. }	—	+
Citrate of soda 1 per cent. } Salt solution }	—	—
Sodium citrate 2 per cent. } Sodium chloride 4 per cent. } in water.....	—	— —
Citrate of soda solution 2 per cent. } Salt solution 3 per cent. }	—	— —

Petrolatum gives a slimy, greasy emulsion appearance, with quantities of opaque lymph and isolated firm adhesions between the intestines. The abdominal incision is poorly healed, its edges are insecurely agglutinated and appear poorly vascularized.

The only death occurring in this series of experiments resulted from the use of iodine in the abdomen. Apparently it was due to the toxic effect of iodine plus a septic peritonitis.

As you see from the table, citrate of soda in salt solution gives the best results. After an impartial scarification, which under normal circumstances at the end of a week would give a nasty peritoneum, with the addition of citrate solutions we have an abdomen practically free from exudate, no adhesions, sometimes the endothelium shows no sign of insult past a hazy opacity and thickening.

These findings are so striking in contrast to all others that they seemed incredible. If it were possible to show by

photographs this difference, the case would be clearly proved; but we must content ourselves with description.

It was apparent from the first that the citrate of soda—2 per cent.—with hypertonic salt solution—3 per cent.—was the best medium used. It was found that hypertonic solutions remained longer in the abdomen than normal solutions. A hypertonic solution colored with methylene blue gave traces of its presence after 48 hours, while normal solutions disappeared in half this time.

At the beginning of this *arbeit* the following questions arose:

First, are we not trying to prevent a natural protective process?

Second, will not capillary hemorrhage be encouraged?

Third, will not infection result, from an interference with the local immunity?

Fourth, will not these solutions be absorbed so rapidly that no good will result from their use?

Fifth, may these solutions themselves be toxic?

The first is the most difficult to answer. But we may change the question by asserting that Nature does not always work best alone and we are assisting rather than interfering.

To answer the second, two experiments were tried in which citrate solutions were employed after voluntarily severing many small vessels of the intestinal subserosa. No evidence of hemorrhage was found at autopsy one week later.

For the third question it must be said that rabbits are very resistant to abdominal infection and that we lost but one animal in the entire course of some 60 laparotomies, even in the face of rather indifferent asepsis.

The fourth question is answered by our success. In peritoneal post-operative inflammation, the height of the storm is past in 48 hours. The solution is present when most needed. When the insulted, traumatized endothelium is pouring out plastic exudate, with a large content of fibrin ferment, it is met by the inhibitory action of citrate of soda.

To test the toxicity of citrates and oxalates five grains each

in one-half ounce of salt solution were injected intravenously in two rabbits. It had no apparent effect on these animals.

It is conceded that probably the best medium for carrying the citrate solution has not been found, and that I have not taken into account the problem of colloids. It is quite likely that further investigation with these questions in view will throw much light upon the subject. Another feature of the work is that upon the introduction into the abdomen of these hypertonic salt solutions with or without citrates, there is always a marked peristalsis with an accompanying contraction of the abdominal muscles, which often rouses the animal from anaesthesia, and seemingly is painful. This quickly passes, and there is no evidence of local irritation—in fact, reddened and ecchymosed intestines become less vascular and more normal in color.

It is not assumed that citrate solutions will prevent adhesions where large denuded areas of the peritoneum are exposed. These should be treated by omental grafts or mesenteric plication. These laboratory results seem applicable only as a mild preventive measure during abdominal operations, which ordinarily tend to leave more or less agglutination and troublesome post-operative adhesions.

It is *not* suggested that large quantities of solution be left in the abdominal cavity, although in the absence of pus it probably is not detrimental so to do, but that the usual operating room solutions of normal salt have added to them a one or two per cent. of citrate of soda.

For the past month, Dr. Terry has employed a 3 per cent. salt with a 2 per cent. citrate solution in all abdominal work done at the University Hospital. It is not easy, of course, to determine how much good this does as a preventive, but from all visible signs in the laboratory, it certainly seems not only theoretically correct and far superior to any means hitherto employed, but is unquestionably of marked practical advantage.

INCIDENCE OF GALL-STONES AND OTHER CALCULI AMONG LABORERS IN THE PANAMA CANAL ZONE.*

BY H. C. CLARK, M.D.,

OF ANCON, CANAL ZONE.

(From the Board of Health Laboratories.)

THE labor force employed by the Isthmian Canal Commission is chiefly drawn from the negro population of the West Indies, therefore abundant opportunity is offered at Ancon Hospital for an anatomical study of young male negroes. Findings not infrequently occur here which are so at variance with the old ideas in regard to the influence of race, sex, age, and climate, that it is interesting to group certain factors for comparison and study.

A supposed immunity has always been granted the negro in respect to gall-stones. Keen¹ writes as follows: "I formerly thought gall-stones occurred in full-blooded negroes with extreme rarity. During fifteen years of practice in Louisville, Ky., I never saw a case in the colored race."

After ten years' experience in five of Philadelphia's hospitals, he later claims to have seen only one case. His correspondence with other surgeons, many of them in Southern States, led to almost the same findings. Pennsylvania Hospital, located in a portion of the city of Philadelphia near a large settlement of negroes, was able to report to him a few cases.

The negro apparently enjoys the same reputation with reference to urinary calculi, but is admitted to be less immune to vesical calculi, although the latter is reported by one authority to occur once in 55,305 blacks.

Osler² states that biliary calculi probably occur in from five to ten per cent. of all autopsies in the temperate zone, being uncommon in the tropics. Hektoen and Riesman³ claim

* Permission for publication granted by the Acting Chief Sanitary Officer, Colonel John L. Phillips, U. S. A., M. C. Thanks are due Dr. Samuel T. Darling for many helpful suggestions.

that biliary calculi, after the sixteenth year, are found in 25 per cent. of all bodies. Naunyn, in more than 9000 autopsies, finds that one case in every thirty had calculi.

All authorities seem to agree that the primitive races are possessed of a high degree of immunity from calculous formations.

Having recently completed a series of 1500 consecutive post-mortem examinations at Ancon Hospital, a review was made to determine the frequency of calculi of various types. Thirty-nine instances of biliary calculi were found, and classified with reference to race as follows:

Race.	Autopsies.	Biliary Calculi.	Per cent.
West Indian negro.....	1088	24	2.2+
Spanish—Indian (mixture).....	230	9	3.9+
Spain (white).....	108	3	2.7+
U. S. A. (white).....	25	1	
Italy (white).....	17	0	
Greece (white).....	7	0	
China (white).....	6	0	
England (white).....	5	0	
Germany (white).....	3	0	
France (white).....	3	1	
Unknown.....	8	0	

In classifying according to age and sex, the Ancon Hospital series will be compared with the Pennsylvania Hospital (Philadelphia) series reported to Dr. Keen by Dr. W. T. Longcope:

	Autopsies Pennsyl- vania Hospital.	Autopsies Ancon Hospital.	Pennsylvania Hospital.	Ancon Hospital.
Under 30 years of age.....	1	11	Males 15	Males 28
From 30 to 40.....	5	12	Females 16	Females 11
From 41 to 50.....	14	8		
From 51 to 60.....	6	3		
From 61 to 70.....	4	4		
Over 70.....	1	1		
Total.....	31	39	31	39

Pennsylvania Hospital: Number of autopsies in series, 1050.

Ancon Hospital: Number of autopsies in series, 1500.

This shows for the Pennsylvania Hospital a percentage of 2.95 + and for Ancon Hospital 2.6. No race entry was given in the Pennsylvania Hospital report, but a personal acquaint-

ance with that institution enables me to state that they deal principally with the white race.

No safe deductions can be made from a comparison of the age grouping in these two lists, for as has already been stated the Ancon series contains chiefly young male negroes. It is interesting to note, however, the number that has been found in the earlier decades of life. Considering the small number of females autopsied at Ancon Hospital it would appear that the females of the tropics would bear out the old idea of the prevalence of biliary calculi in their sex. Naunyn's theory that gall-stones are the result of a pathological alteration in the mucous membrane of the gall-bladder usually excited by the presence of bacteria, and leading to an increased deposition of lime and cholesterin, has met with general acceptance. Many instances are recorded which show that local infection is the chief factor in bringing about biliary lithiasis. If this is the case, then the negro of the tropics is thrown open to more etiological factors because he is often subjected to various forms of enteritis and colitis, which frequently run a chronic course. He is also exposed to the influence of such diseases as malarial hæmoglobinuria in which pathological conditions in the biliary passages have been noted. Thus several additional factors may be at work in the tropics that are not encountered in the temperate zones.

An effort has been made to group the causes of death in the cases revealing gall-stones and also to group the evidences, past or present, of chronic infections which might throw light on the etiology. The causes of death in the 39 cases are as follows:

Lobar pneumonia,	7	Mental diseases,	2
Pyæmia,	4	Dysentery,	1
Intestinal obstruction,	3	Hæmoglobinuric fever,	1
Chronic nephritis,	3	Gastric and duodenal ulcers,	1
Tuberculosis,	3	Apoplexy,	1
Traumatism,	3	Aneurism,	1
Purulent infection of genito-		Senility,	1
urinary system,	2	Anæmia,	1
Cardiac diseases,	2	Diabetes mellitus,	1
Meningitis,	2		

Classification of other findings, occurring singly or in some combination, which may represent the origin of the influences predisposing to gall-stone formation:

Chronic adhesive perihepatitis and perisplenitis	14 times
Pelvic diseases of chronic inflammatory nature	5 times
Chronic fibrous peritonitis, general	5 times
Chronic ulcerative colitis	5 times
Chronic ulcers or cicatrices in duodenum and stomach	4 times
Chronic ulcers and cicatrices in ileum and cæcum	1 time
Hernia, inguinal	2 times
Fibromyomata uteri (large masses)	3 times
Multiple pregnancy	1 time
Pancreatic disease	1 time
Cases with negative histories and no old lesions	8 times

In none of these cases would it seem likely that gall-stones had played a part in the cause of death unless it be that the pancreatic disease present in the case of diabetes mellitus was a sequel to the cholelithiasis.

To the list of predisposing factors may be added the note that in most all of the cases malarial pigment was present in spleen, liver, and marrow. In malarial hæmoglobinuria marked inspissation of the bile occurs. It is not unlikely that such an influence or condition may be an etiological factor in the causation of gall-stone in the tropics.

In the series of 1500 autopsies, scars or ulcers were found in the stomach 31 times and in the duodenum 25 times. Reference to the tables given will show that ulcers of the duodenum and stomach had been a cause of death in one instance where gall-stones had been found, and in the table of predisposing factors one sees the entry of ulcers and cicatrices four times, and of intestinal lesions eight times. Peritoneal infections, ascending intestinal or local intestinal infections would appear to be very important factors. Large masses of myofibromata and pregnancy in a mechanical way might produce stagnation of the bile.

It is difficult to draw conclusions as to the incidence of gall-stones in the tropics, but it is evident that the Ancon Hospital series offers proof that the black man from the West Indies furnishes a greater percentage of cases of biliary

calculi than does his brother of the temperate zone. The clinical records at Ancon Hospital lend further proof of this, for not infrequently cholelithiasis has been the indication for surgical intervention. The attention being paid to the coincidence of gall-stones with other surgical diseases is well shown by a recent review of the laparotomies done in the service of each of three American surgeons. Dr. J. G. Clark⁴ finds 27 instances of gall-stones associated with myoma uteri; 56 instances with other abdominal conditions chiefly of a pelvic nature. Dr. C. H. Mayo⁵ records 1244 operations for myoma uteri in which there were 90 cases of coincident cholelithiasis. Dr. Philemon Truesdale⁶ reports 500 laparotomies for pelvic conditions with 34 instances of associated gall-stones.

It would appear from this that Dr. Osler's statement in regard to biliary calculi as probably occurring in from 5 to 10 per cent. of all autopsies in the temperate zone would indicate the general prevalence. Since the analysis of the Ancon series another case of special interest has fallen into my hands which seems to deserve a brief note.

Case 139,790 was a black, male child of four months, which died of acute enterocolitis and as a contributing factor possessed a congenital cardiac defect, a patent foramen ovale, with hypertrophy of the right side of the heart. Cholelithiasis was a coincident factor. The gall-bladder was under some tension from its content of clear watery fluid. When this escaped two gall-stones were found. Each was about twice the size of a wheat grain and black in color. One was loosely engaged in the cystic duct at its entrance and the other free in the gall-bladder. The ducts were patulous.

The combined weight of the two stones was 0.0295 grammes. They were subjected to a chemical examination by Mr. J. E. Jacob. The results, in brief, indicated a formation due to biliary pigments and some calcium oxalate. Cholesterin was absent.

Osler states that cholelithiasis is rarely encountered in infancy and childhood and that when it does occur it is doubtless due to intra-uterine infection. Maternal history in this instance was of no aid but the anatomical findings would in-

dicates an ascending intestinal infection as the etiological factor were it not for the extreme youth. It, at least, raises the question of the time required for such formations to occur.

Attention is directed to the disproportionate incidence of gall-stones among the cases of pyæmia and of intestinal obstruction.

Pyæmia (4 cases) and intestinal obstruction (3 cases) occupy an unusually conspicuous place as a cause of death in this series without being directly related to the gall-stone condition.

It seems possible that the causes favoring gall-stone would favor pyæmia, and on the other hand the cause favoring intestinal obstruction by favoring infection would further the processes leading to gall-stones.

The association of hernia might also be classed as an etiological factor because even moderate occasional constriction of the bowel favors the entrance of intestinal bacteria into the blood stream.

LITHIASIS OF THE URINARY PASSAGES.
Tabulated Cases.

Race.	Age.	Sex.	Location of Calculus.
West Indian, negro...	47 years	Male	Three or four calculi in each kidney.
West Indian, negro...	21 years	Male	Right kidney.
West Indian, negro...	70 years	Male	Vesical calculus (prostatic disease).
West Indian, negro...	68 years	Male	1 small stone—pyramids calcified.
West Indian, negro...	4 days	Male	Calcification of the pyramids.
West Indian, negro...	11 days	Male	Calcification of the pyramids.
U. S. A., negro.....	43 years	Male	Bilateral ureteral calculi.
Spanish, Indian.....	87 years	Male	Vesical calculus (prostatic disease).

In these instances urinary lithiasis was only found in the male sex.

The number of negroes and individuals of Spanish-Indian mixture in this series of 1500 is 1318, the cases revealing some type of urinary lithiasis being eight. The clinical records at Ancon Hospital show a corresponding dearth in the negro.

In the two black male babies the condition manifested itself in the form of a "sand deposit" in the pelvis of each kidney and in the pyramids. It was so marked that the condition

seemed worthy of special mention. This has been frequently noted, though, to a less degree in babies and very old people, and also in certain cases of chronic nephritis. Holt,⁷ basing his statement on 1000 autopsies on infants, states that granular deposits are generally seen in both kidneys, the pyramids not infrequently are calcified and rarely a calculus found.

In the two cases of vesical calculus extreme age and prostatic disease were present. In both instances a large soft stone was found.

The most interesting case of the series is the one tabulated as bilateral ureteral calculi. This was in a male negro laborer, forty-three years of age, from Virginia, who had lived for the past five years in a suburban division of Panama City. In each ureter a calculus was found at autopsy (A-3195) lodged just above the brim of the pelvis. The anatomical findings were chiefly cardiovascular and renal, with hydronephrosis superimposed. Syphilitic aortitis and small gummata in the liver were also found. In the left ureter there was found at the pelvic brim a calculus measuring 7 mm. in diameter and about 2 cm. long. In the right ureter at a similar point was another calculus 7 mm. by 1 cm.

The dried ureteral calculi were given to Mr. J. E. Jacob for chemical analysis. His report is appended: "The two calculi weighed approximately 0.6 grammes each. The cross-section of the calculi showed alternate layers of yellowish and yellowish-red material. They were found to be composed principally of uric acid with a small amount of ammonium urate. A trace of albuminous matter and ether soluble substance was also present."

Albarran⁸ regards the presence of stone on both sides as an argument in favor of the systemic origin of renal calculi, the fact that they are not always found on both sides being due to the absence on one side of a nucleus upon which to deposit crystals, or to the calculus being voided before reaching considerable size, and in some instances to the ureter dilating and allowing even a large stone to pass into the bladder. The skiagraph in many instances reveals bilateral calculi, thus bearing out his view.

Lusk,⁹ Mendel,¹⁰ and others in their study of the formation and elimination of uric acid lend supporting evidence to the systemic origin of calculi.

Pancreatic Calculi.—This type occurred twice in the series. Once in a male negro of 21 years associated with biliary calculi in the cystic duct and extensive acute and chronic pancreatitis, diabetes mellitus being a sequel. Two long cylindrical calculi were found lying end to end in the dilated ducts about the middle of the pancreatic body.

The second occurrence was in a male negro of 44 years. Here a most extensive chronic interstitial pancreatitis was found with focal areas of acute pancreatitis wherever large tufts of tissue remained. No glycosuria was associated. The concretions were found throughout the organ in the form of shot-like collections of sand. Two cases of pancreatic calculi have been reported in a series of 1500 autopsies at Johns Hopkins Hospital. They are said to be infrequently met with, though I can find no other records at hand which would give an idea of the incidence of these calculi.

Salivary Calculi.—None appeared in the autopsy series but one instance was found in the surgical service of Dr. A. B. Herrick and is sufficiently rare to merit recording. A bullet-like calculus was found in the submaxillary gland removed from a male Barbadian negro of twenty-eight years. A ranula had formed and a superimposed acute and chronic inflammatory process was found. Mr. J. E. Jacob's report on the calculus was as follows: weight 0.4320 grammes; composition chiefly calcium and ammonium phosphates; traces of sodium, iron, phosphoric acid, and albuminous matter also present.

These concretions are said to occur five times more frequently in the submaxillary than in any of the other salivary glands.

Concretions of the Tonsil.—Infrequently the tonsillar crypts have contained irregular concretions probably resulting from diseases which have closed the exit of the crypts and allowed a calcareous degeneration to follow. These have sometimes had a diameter of from 4 mm. to 8 mm.

Appendiceal Concretions.—The occasional foreign body in the centre of concretions found elsewhere has to a certain extent been noted at Ancon. The only noteworthy exceptions that have attracted attention were two cases: one in which the dead body of an uncinaria or tricocephalus worm formed the nucleus and a second instance where several ova of *Trichuris trichiura* occupied the centre of a dried concretion.

SUMMARY.—(1) The findings at this hospital indicate a much less frequent occurrence of biliary calculi in the negro than in the white race living in the temperate zone, but they tend also to show a much greater incidence in the negro of the tropics than in his brother of the temperate zone.

(2) Suggestive factors relative to etiology are the prevalence of enteritis, colitis, and malaria, especially the intestinal diseases.

(3) Ancon Hospital findings would also indicate a higher percentage of cholelithiasis among the Old World Spaniards than authorities are willing to grant.

(4) Calculi of the urinary passages in the negro would appear to be extremely rare.

(5) One case lends argument in favor of the systemic origin of renal calculi.

(6) Intestinal nematodes may directly be the etiological factor in certain cases of appendicitis associated with fecal concretions by producing a portal of entry for infection in the mucosa of the appendix; or indirectly by furnishing the nucleus for a concretion and its frequent sequel, appendicitis.

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INTERSCAPULOTHORACIC AMPUTATION OF THE SHOULDER WITH COMPLETE EXCISION OF THE CLAVICLE.

A REPORT OF THREE CASES.

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EXCISION of the entire clavicle may be advisable in interscapulothoracic amputation of the shoulder: (*a*) when the outer end of the bone is involved by malignant disease; (*b*) when the contiguous parts are so closely involved as to make the immunity of the clavicle uncertain, or (*c*) when the integument requires such extensive excision that the covering of the clavicular stump would make undue tension.

The cutaneous incision must be varied according to the location of the disease. The typical incision begins over the inner end of the clavicle, and extends outward around the base of the neck and backward above the upper border of the scapula. From both ends of this incision curved incisions with the convexity outward are carried down to a point in the axillary line opposite the lower angle of the scapula. The incision over the clavicle is carried firmly down to the bone, freely exposing the inner half but continuing it around the neck, and making also the anterior incision. The inner end of the clavicle may then be detached by severing the muscles and articular ligaments very close to the bone, being, of course, exceedingly careful not to wound the pleura or subclavicular vessels. As soon as the upper surface of the sternoclavicular articulation is opened, the assistant draws the clavicle forward and the posterior part of the articulation may be safely severed by short snips, with a pair of heavy blunt-pointed scissors. When this is loosened the clavicle is readily drawn down and out, and further detached until the vessels are well exposed. They are then ligated by passing the ligature with an aneurism

needle, being careful not to tear the thin-walled vein by rough handling. Linen or silk ligatures should be used. After the division of the vessels the brachial plexus is raised and severed with a sharp knife. I have not in any instance cocaineized either these nerves or the sciatic before severing them in amputations, and have not seen any evidence of shock from this part of the operation. After the severing of the vessels and nerves the pectoralis muscles are cut close to their origin. The shoulder may then be readily turned back, raising the scapula from the chest wall and giving ready access to its attachments and vascular supply from the front. When this is done the operation is completed by making the posterior flap and the subcutaneous separation of the scapula.

Done in this way but little blood should be lost, and the operation is completed with facility, and with so little attendant shock that in all of the three cases here reported the patients were able to sit up in bed on the morning following the operation, and were permitted to walk about in a few days.

CASE I.—Lad of twelve years. During the absence of the family physician on a vacation, a swelling just above the middle of the left arm was noticed. It was slightly painful, and a neighbor, who was consulted, diagnosed it as rheumatism and prescribed osteopathic treatment. The plan was adopted and the lump received daily rubbing for several weeks, until the family physician returned. In the meantime it had greatly increased in size. On examination he found that spontaneous fracture had already taken place, made a diagnosis of sarcoma, and sent him to me for operation. A trans-scapular amputation was done, removing all of the shoulder-joint, the bone being sawed vertically through the middle of the scapuloclavicular articulation. The wound healed promptly, but within a week after the removal of the dressings a lump was discovered on the outer border of the scapula near the lower end of the cicatrix. Interscapulothoracic amputation with complete excision of the clavicle, as just described, was done at once. A liberal portion of integument over and about the growth was removed with it. Recovery was prompt

and evidently permanent, as the photograph herewith shown was made two and one-half years after the operation (Fig. 1).

CASE II.—Man, aged forty-eight. A pigmented mole at the back of his left shoulder became sore, and he consulted his physician, who at once excised it freely under local anæsthesia. It healed promptly. A few weeks later at the urgent solicitation of a friend, who had recently taken the agency of a life insurance company, he reluctantly consented to take a policy. The examiner passed him without objection, though the excision of the mole was mentioned. A few weeks later the axillary glands on the same side began to enlarge rapidly, and the scar became sore. He was brought to me for examination, and frozen sections of a piece of tissue removed from the scar showed melanoma. The axillary glands at this time were the size of a man's fist. He complained of pain in his chest, but careful physical examination was negative. As the involved glands were in close proximity to the clavicle, it was decided to remove it entire in the interscapulothoracic amputation. His operative recovery was prompt. The photograph shown (Fig. 2) was made three weeks after the operation. The pain in his chest had increased. This may be seen in the facial expression. Two months later he died with an enormous metastasis in the liver.

CASE III.—Sarcoma of the arm following injury. This is the most rapid growth of sarcoma of traumatic origin that I have been able to find any record of. Cobb, quoted by Carson in the *ANNALS OF SURGERY*, June, 1913, mentions a case where local excision was done eight weeks after the injury, and this was followed by recurrence, which was then successfully circumvented by an interscapulothoracic amputation. Senn (*Tumors*, page 260) where radical operation was recommended ten weeks after fracture of the thigh. The abundant growth was discovered after the removal of the splints. Operation was refused, and the patient died from sarcoma. In this case, undoubtedly, the growth might have been evident several weeks earlier had it not been for the fracture dressings. In the case I am reporting the young man received a blow just above the inner side of the left elbow by the recoil of an automobile crank on the night of August 4, 1912. The blow was severe and painful, but he was

FIG. 1.



Case I.

FIG. 3.



Case III.

FIG. 2.



Case II.

Figs. 1-3.—Interscapulothoracic amputation.

FIG. 4.



Case IV.

FIG. 5.



Case IV.

able to resume his usual work the next day, and continued to drive an automobile truck for three weeks. Increasing stiffness of the arm, however, caused him to give up his work, and he went to the country. At this time a swelling of the anterior side of the arm began, and presently extended half way to the shoulder. He consulted a physician, who found bone deposits scattered throughout the enlargement, made a tentative diagnosis of sarcoma, and sent him in for further examination. Examination of the arm five weeks after the accident showed a hard enlargement of the anterior side of the arm firmly attached to the humerus, and extending from the elbow beyond the middle of the arm. A radiograph showed the shaft of the humerus intact, but scattered throughout the mass were irregular patches of bone. The elbow was flexed at a right angle, and permitted but a few degrees of motion. A consultation of surgeons was called, and the probability of sarcoma was agreed upon. It was also thought possible that a benign proliferation of bone tissue, myositis ossificans traumatica, throughout the adjacent muscle might have taken place. It was agreed to call in several consulting pathologists and to examine sections of the suspected tissue before proceeding to any radical operation. The frozen sections were prepared by a recent graduate of Harvard. The consulting pathologists were graduates of Johns Hopkins and the University of Pennsylvania. Their diagnosis of sarcoma was accepted by the consulting surgeons. The photograph shown (Fig. 3) was made 8 months after the operation.

CASE IV.—Girl, aged seven, in January began to have “growing pains” in the left arm. In March a swelling appeared at the upper part of the arm. In April a surgeon diagnosed sarcoma, and recommended amputation of the arm. This was refused, but a conservative operation consented to. The lump was removed and the bone scraped. Local recurrence was rapid. In June the child was taken to a cancer doctor, who applied caustic pastes, which produced a large eschar, which still remained on the growth at the time photograph (Fig. 4) was made, the day before my operation. The sarcoma, however, continued to grow below the eschar and the arm increased much in size. Interscapulothoracic amputation with complete excision of the clavicle was done. Fig. 5 is from a photograph made one week after the operation. The improve-

ment of the child's general condition in this short time was very marked. The growth presents a distinct reticulum of rather long cells sparsely enucleated. The alveolæ are filled with ovoid cells.

It is here proposed that complete excision of the clavicle in interscapulothoracic amputation of the shoulder, when done as described, presents but little, if any, greater danger or technical difficulty than the method of Berger, and that in at least a considerable proportion of cases this should be done to make the operation more radical.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

*Stated Meeting, held at the New York Academy of Medicine,
October 8, 1913.*

The President, DR. FREDERIC KAMMERER, in the Chair.

POLYCYTHÆMIA: HYPERNEPHROMA: NEPHRECTOMY.

DR. CLARENCE A. McWILLIAMS presented a man, fifty-nine years old, who was admitted to the Presbyterian Hospital on February 26, 1913, with the history of hæmaturia, of sudden onset and of five days' duration. He had first noticed only a drop of bright, red blood just at the end of urination, the urine both before and after this being clear. Two days later he passed several small strings, and three hours afterward, on attempting to urinate, he could pass only a few bloody clots, but no urine. He saw a physician, who catheterized him, affording him great relief. There was no history of increased frequency, pain, tenesmus nor loss of control.

The cystoscope showed a markedly trabeculated bladder, with no evidence of inflammation, neoplasm nor foreign body. There was moderate enlargement of the median lobe of the prostate, as well as of the anterior lobe. The ureteral orifices could not be located. An X-ray was negative. Palpation of the abdomen revealed a small, indistinct, non-tender mass, about the size of a plum, in the vicinity of the spleen. Otherwise the examination was negative. The urine contained a trace of albumin, with hyaline, granular and bloody casts and free blood; no pus. The blood-pressure ranged between 180 and 220 mm. An examination of the blood gave 8,800,000 red cells; hæmoglobin, 110 per cent.; no myelocytes.

The patient, who at this time was under observation in the medical wards of the hospital, had some cyanosis of the hands

and lips. There was no history of headaches, syncope, dyspnœa, palpitation, precordial distress nor pain; no cough nor gastrointestinal symptoms; no epistaxis, hæmoptyses nor hæmatemesis; no melæna nor nervous symptoms. He had never been jaundiced nor lost strength. The only symptom he complained of was hæmaturia.

An examination made at this time revealed a systolic murmur at the base and apex. The arteries were moderately thickened and there were many tortuous veins over various regions of the body. On the left side of the abdomen, just beneath the costal arch, was a mass extending downward for three inches, and at the costal margin projecting forward to the anterior axillary line. It was irregular in outline, firm to pressure and did not give rise to tenderness. The provisional diagnosis on the medical division was polycythæmia, with enlargement of the spleen, and cyanosis.

A cystoscopic examination made on March 11, 1913, revealed a worm-like cast of the ureter protruding from the left ureteral orifice. A phthalein test made immediately after this showed that 32 per cent. of the drug was excreted during the first hour and 10 per cent. in the second hour; 42 per cent. in two hours. Since the left ureter was plugged with a blood clot, it was argued that the right kidney was doing all the work. A Wassermann test was made with negative results.

After inflation of the colon with air, the medical history stated that the evidence pointed to a tumor of the spleen, because there was no tympany in front of it. Subsequent operation showed that the tumor that had been made out was a large kidney, which did not allow the colon to pass in front of it because it filled up the entire space between the anterior and posterior abdominal walls and had pressed the colon inward. The medical men explained the hæmaturia as being a hemorrhage of the kidney due to polycythæmia, as bleeding often occurs in this condition, although hemorrhage from the kidney seems to be rare.

Dr. McWilliams said the case continued to excite much interest in the hospital, the medical men regarding the tumor as an enlarged spleen, while the surgeons were inclined to look upon it as a tumor of the kidney. At any rate, the surgeons maintained that an exploratory operation was advisable, and this was done by Dr. McWilliams on April 7. Upon opening the abdomen, the spleen was found to be small and pushed forward against the

diaphragm. The left kidney was easily enucleated together with its fatty capsule and removed, after separating and tying off the ureter.

Pathologically, the lesion proved to be a hypernephroma of the kidney, and an interesting feature of the specimen was that one branch of the renal vein was invaded by a pedunculated tumor mass, presenting from above, the free surface of this tumor being covered by a definite, unbroken capsule of connective tissue. It was found that the nephrectomy had been done wide of the tumor.

On the day following the operation, a blood count showed 686,400 red blood cells, with 85 per cent. of hæmoglobin. The systolic blood-pressure at that time was 170 mm.; diastolic, 105 mm. The patient's recovery from the operation was uneventful.

Five months after operation the blood examination showed 8,200,000 red cells, and white blood cells 6,100. Phthalein test showed that the color appeared in the urine in 16 minutes; 39 per cent. was recovered in the first hour and 14 per cent. in the second hour, a total of 53 per cent. in 2 hours. The man was perfectly well, was working every day and there was no evidence of any recurrence which could be detected in any way.

DR. H. H. M. LYLE said Dr. McWilliams's case was a beautiful example of the fact that a hypernephroma might remain as a localized tumor for a considerable time and that dissemination took place by the way of the veins. Masses of hypernephromic tissue could be seen in the veins of the specimen. In the ordinary course of an operation it would be next to impossible to prevent the squeezing of such masses into the general circulation unless a preliminary ligation of vessels was made. For this reason Dr. Lyle is firmly convinced that the most important step in the whole operation is the ligation of the vessels as near to the mid-line as possible. In order to carry out this cardinal point a good exposure is necessary, and this can be obtained by the employment of the transverse incision or a modified Perthes.

DR. FRANK S. MATHEWS recalled a case where a man, twenty-four years old, complained of a persistent backache in the lumbar region, the pain being so severe that he gave up his work. There were no urinary symptoms whatever, and the case for a time was regarded as one of malingering. Subsequently, a small tumor was removed from the base of the neck and two pathologists, examining it independently, pronounced it a hypernephroma.

DR. WILLY MEYER said that about a year ago he removed a hypernephroma in a case where there was no history of hæmaturia, and a few days ago he saw an exactly similar case. These cases were of importance, because the diagnosis was usually based on the history of blood in the urine without pain, the symptomless hæmaturia.

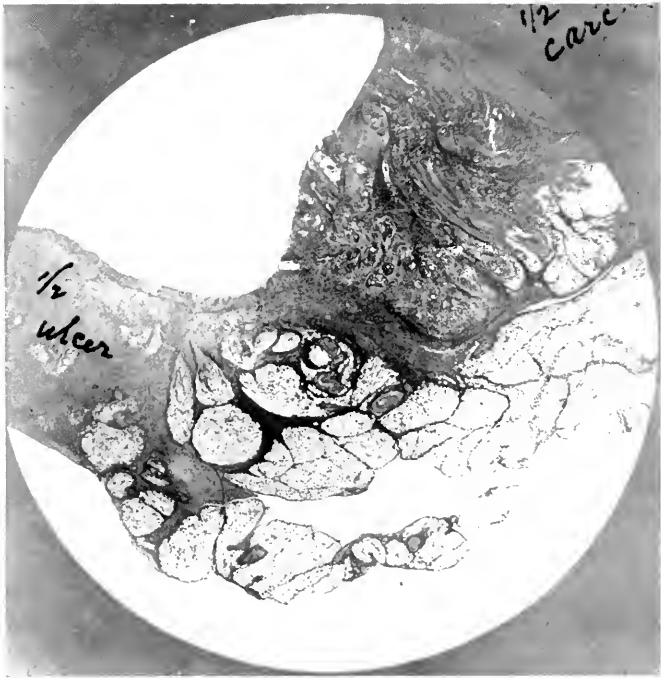
DR. N. W. GREEN said that two or three years ago, at the City Hospital, he was asked by the medical side to operate on a case of supposed empyema. He opened the pleural cavity and evacuated a quantity of turbid fluid which did not look like the ordinary pus of empyema. The patient gave no symptoms of urinary or abdominal trouble. Death occurred within a few days and the necropsy revealed a hypernephroma of both kidneys, with secondary deposits in the lungs.

DR. HOWARD LILIENTHAL said that one aspect of these cases had not been referred to, namely, the possibility of bone metastases. These, in his experience, were comparatively common, and in every case of hæmaturia of unknown origin coming under his observation he always examined the bones, especially those of the head, the sternum and the ribs. He could also recall cases where there were metastases in the long bones. The speaker emphasized the statement made by Dr. Meyer that blood in the urine, even in microscopic quantities, was not always found in hypernephroma. The tumor itself was usually very vascular before it broke down into the yellow honey-like variety, and ruptured on small provocation. He had seen, perhaps, half a dozen of these cases, and in one instance he was able to make the diagnosis of secondary hypernephroma from a deposit in one of the ribs.

ULCER OF THE STOMACH, WITH MALIGNANT DEGENERATION.

DR. W. B. BRINSMADE, of Brooklyn, presented a man, forty years old, a machinist, who had an "ulcerated condition of the mouth and throat" as a child, supposed to have been contracted from being kissed. His nasal septum was removed when he was a child. He had jaundice and malaria while living in Brazil. Had a chancre and bubo twenty-five years ago, but no secondary manifestations of syphilis. He has been a heavy drinker and smoker. Wassermann reaction was negative.

FIG. 1.



Ulcer of stomach with malignant degeneration.

About five years ago he began to have attacks of epigastric pain which were relieved by eating. Since then he gives the characteristic history of gastric ulcer, with increasing loss of weight and inability to work.

Upon operation, a very large ulcer was found on the posterior wall of the stomach, extending to the lesser curvature. There was also one enlarged, hard gland at the greater curvature. On March 19, 1913, a resection of the pylorus and about one-half of the stomach was done, the jejunum being united to the stomach about three inches from the cardia.

The patient made a good recovery and was discharged on April 4, his one complaint at the time being that his stomach seemed to hold very little. A microscopic examination of the excised gland showed it to be adenocarcinoma, as did also the margins of the indurated ulcer.

This case, Dr. Brinsmade said, was offered as an addition to the many proofs that ulcers of the stomach might degenerate and become malignant.

The microphotograph shows distinctly the crater of the ulcer with destruction of mucous membrane. The right side of the picture shows carcinoma (Fig. 1).

DUODENAL ULCER: POSTERIOR GASTRO-ENTEROSTOMY.

DR. BRINSMADE presented a man, thirty-five years old, who had been under treatment for five years for dyspepsia, giving the usual history of such cases. Upon operation, a rather large ulcer of the duodenum was found. Dr. Brinsmade did an ordinary posterior gastro-enterostomy, without closure of the duodenum, and the patient made a perfect recovery. Since the operation, which was done on the first of January, 1912, he had enjoyed excellent health and had gained over thirty pounds in weight.

PYLORECTOMY FOR RECURRENT GASTRIC ULCER.

DR. BRINSMADE presented a woman, thirty-three years old, who gave a history of having spent several months in bed, suffering from severe gastric symptoms, *i.e.*, pain, vomiting, with blood both in the vomitus and in the stools, and emaciation. Upon operation, an indurated ulcer, about the size of a silver dollar, was found on the anterior wall of the stomach. The appendix was found to be the seat of a chronic inflammation, and was removed.

The gastric ulcer was treated by inversion, thus cutting off its blood supply, and the patient made a very good recovery.

Following this operation, which was done in January, 1911, the patient gained 27 pounds in weight and returned to her vocation, which was that of a teacher. Soon afterwards, she again began to lose weight, and by the following January her gastric symptoms were as severe as they had been prior to the operation. Accordingly, on June 12, 1912, the stomach was again exposed, and a large indurated ulcer was found over the site where the original flat ulcer had been turned in.

A pylorectomy was done, with a wide margin, and a gastro-enterostomy completed the operation, from which the patient again made a good recovery. Last winter she again suffered from vomiting, but upon giving up her work the gastric symptoms gradually improved; she had gained seventeen pounds in weight and was now in excellent condition.

This case, the speaker said, was shown as an example of how a flat ulcer might become converted into an indurated ulcer in the course of one year.

Dr. Brinsmade also exhibited two X-ray plates of a case where he did a gastro-enterostomy fifteen months ago. The first picture was taken within five minutes of the bismuth meal and showed most of the meal in jejunum. The second picture was taken twenty minutes later and showed very active peristalsis. As shown by plates, the stoma in this case was patent. The patient's symptoms had not been much relieved by the operation, and the plates show the reason. This patient, however, has never been willing to act on advice in regard to eating and drinking and it is difficult to determine accurately whether the large patent stoma is the cause of his present discomfort or not.

POSTERIOR GASTRO-ENTEROSTOMY AND ENTERO-ENTEROSTOMY FOR DUODENAL ULCER WITH THE ELASTIC LIGATURE: CONDITION AFTER TEN YEARS.

DR. WILLY MEYER presented a male patient, seventy years old, who first came under his observation ten years ago with the history that eighteen or twenty years before that time—now almost thirty years ago—he began to suffer from severe and repeated hemorrhages from the bowels. These had since recurred intermittently, and had been especially severe during the previous

summer, while absent in Europe, so that when Dr. Meyer first saw him, upon his return to this country, he was very feeble and had lost much weight.

About that time, Dr. Meyer said, he had done a number of gastro-enterostomies with McGraw's elastic ligature with very favorable results, and he thereupon determined to follow that method in this case. During the early stage of the operation, the man had a sinking spell, from which he was revived with difficulty. The operation consisted of a posterior gastro-enterostomy with a No. 3 elastic ligature, long loop, and an additional entero-enterostomy, also made with the elastic ligature. The patient made such a good recovery that two months later he felt equal to attending a banquet and partake freely of all kinds of food, and since that time he had remained in good health. He was now a man of 70, weighing 190 pounds, which was a gain of 90 pounds since the date of the operation. In spite of his apparent good health, however, as far as gastric symptoms were concerned, he had on at least three occasions had tarry stools, the last one a year ago, but without pain.

PYLORIC EXCLUSION FOR DUODENAL ULCER: POSTERIOR GASTRO-ENTEROSTOMY.

DR. MEYER presented a man, thirty-one years old, who came under his care during the past summer through the courtesy of, and after he had been under treatment by Dr. Einhorn, who had made the diagnosis of ulcer of the duodenum. The patient also gave vague symptoms pointing to the gall-bladder.

On June 4, 1913, the abdomen was opened, and upon exposing first the appendix it was found to be much diseased and was removed. The gall-bladder was then exposed and was found to be free from stones and normal in appearance. After loosening the many firm adhesions, the pylorus was brought into view, and two ulcers of the duodenum were found, one near the pylorus, the other lower down. They were inverted by suture and a posterior gastro-enterostomy was done. The patient made a good recovery from the operation.

ULCER OF THE STOMACH TREATED BY DOUBLE LIGATURE.

DR. JOHN ROGERS presented a man, fifty-nine years old, who for 30 years had suffered from sour eructations, with gastric pain

and discomfort, from which he found relief by the use of bicarbonate of soda. An examination of the stomach secretions, made in March, 1913, showed a total acidity of 74, with free hydrochloric acid, 41, and manifest traces of blood.

Upon operation, which was done on March 29, an ulcer was found posteriorly at the upper end of the lesser curvature, its location being such that excision would prove extremely difficult. Dr. Rogers thereupon ligated the gastric artery close to the celiac axis, applying a double ligature with the object of interrupting that part of the sympathetic nerve supply which accompanies the artery. The wound was then closed completely, nothing else being done. The patient made a good recovery; he was now entirely free from gastric distress and was able to eat anything. The total acidity had been reduced from 74 to 27, and the free hydrochloric acid from 41 to 20, no traces of blood. This was the result of an examination of the gastric secretions last April, and the last examination, made a few days ago, gave practically the same figures. The patient had gained steadily in health and strength and said he was now able to enjoy food from which he had been obliged to abstain since he was a boy. There are at present no symptoms and the patient considers himself entirely well.

DR. ROBERT T. MORRIS said he wished to speak of the advisability of inversion in the treatment of certain cases of ulcer. He had resorted to this method several times, both as a matter of choice and expediency, with very gratifying results. In one of his more recent cases the patient had first been operated on by Roux, who did his typical operation, and a year later he was again operated on by Dr. Cullen, of Johns Hopkins, who excised the pylorus. Subsequently, when Dr. Morris opened the abdomen, he found an ulcer situated at the margin of the jejunal opening. The condition of the patient was such that an excision was deemed inadvisable, and he simply inverted the ulcer, using Pagenstecher thread. In that case, the patient died a year later from another ulcer in the jejunum, and at the necropsy it was found that the previous ulcer that had been inverted, although still present, was not an active factor.

DR. ROGERS, speaking of the X-ray plates shown by Dr. Brinsmade, said it was formerly held that a large stoma was the safe thing to do in these cases, but as a matter of fact the gastro-

enterostomy opening could not completely close, and so far as he knew, it never did completely close. By leaving such a large stoma as was done in this case, it permitted the too rapid passage of the gastric contents before their proper digestion had occurred. The stoma should not be larger than the natural pyloric opening. The object of an artificial opening in cases of ulcer was to neutralize the gastric contents by a reflux of the duodenal contents, and if the opening was made too large, it immediately predisposed the patient to the formation of an intestinal ulcer by the too rapid discharge of the acid gastric contents.

DR. LILIENTHAL said that while he had never personally seen a stoma of this kind close, he saw a specimen demonstrated by Dr. Finney, of Baltimore, in a case in which a gastro-enterostomy had been done with the Murphy button. In that case, the opening that remained was barely large enough to permit the passage of a bristle. However, the speaker said he was convinced that the ordinary stoma made by suture was not very apt to close. Whether the trauma following the use of the button predisposed to such closure or not he did not know. Certainly in Dr. Finney's case the stoma had practically closed.

Speaking of the size of the opening, Dr. Lilienthal said that last summer he had an unfortunate experience where he thought that the fatal outcome was due to the fact that the stoma was too large. The patient developed a vicious circle and was not benefited by a subsequent operation. In a more recent case in which he operated he was very careful to avoid this error, making the opening just large enough to admit the tips of two fingers.

Dr. Lilienthal said that on previous occasions he had emphasized his opinion that pylorotomy should be done in two stages, especially if the patient was in a weakened condition. During the first stage (gastro-enterostomy) the operator could determine exactly what would have to be done, and at the end of two weeks, or perhaps three, the patient would be in a much safer condition for the second stage of the operation—the actual pylorotomy. To complete the operation at a single sitting occupied too much time, the shock was oftentimes too great, while an added disadvantage was that we often had to operate on tissues that were inflamed and, perhaps, with a perigastritis present.

DR. McWILLIAMS said that in a recent issue of *Surgery, Obstetrics and Gynecology* there was an article in which an author

attempted to refute the results of Cannon and Blake's experiments on dogs in connection with pylorotomy. Six cases of gastro-enterostomy were reported, in four of which it was shown that the gastro-enterostomy opening was patent, while in two of them the bismuth test showed that it passed through both openings. This author stated that proper drainage in gastro-enterostomy was secured by making the opening at the lowest portion of the stomach, and he maintained that Cannon and Blake's observations were erroneous when they said that a gastro-enterostomy did not afford drainage.

DR. GREEN said he took it for granted that the two-stage operation advised by Dr. Lilienthal did not apply to cases of acute perforating ulcer. The speaker said that during the last fifteen months he had seen four cases of acute perforating ulcer of the duodenum and one case of perforating gastric ulcer. In every one he did a posterior gastro-enterostomy after folding in the ulcer. All his cases recovered with the exception of one, where the perforation had taken place 27 hours before the patient came to the operating table.

DR. WILLY MEYER said that he also believed in the inversion of ulcers, and had done it wherever possible. In that connection he desired to call attention to a recent paper by Seidel, of Dresden, in which he showed that even in very badly infiltrated ulcers, by placing the sutures properly, the ulcer could be covered.

As to peptic ulcers, the speaker said he felt assured that the too rapid exit of the gastric contents into the duodenum would in a number of cases be the exciting cause of such ulcers. We should not place the gastro-enterostomy opening too close to the cardia, rather closer to the pylorus, and it should not be too large. In these cases he usually advised his patients to drink large quantities of a solution of bicarbonate of soda.

On the other hand, we should not make the opening too small. Personally, he had never seen such a stoma close if made with sutures, but he had seen it close after the use of the Murphy button, and others had reported a similar occurrence if the pylorus remained patent. In dealing with duodenal ulcers, he thought we should exclude the pylorus. The most radical method for this purpose was that of von Eiselsberg, transverse division of the stomach in front of the pylorus with stoma of either end. In this connection he would again call attention to the value of

the wire-stitching instrument of Huelst as a rapid means of performing this operation. One method that had been suggested for effecting the exclusion of the pylorus was to strongly tie off the stomach very close to the pylorus with a silk thread, which of course would perforate later on, and place in the groove covering the thread a twisted cord-like piece of omentum, which was tightly wrapped around it, producing the exclusion by autoplasty, as we might term it. Dr. Charles Mayo had used the omentum minor for this purpose. Whatever the means adopted, the speaker thought that with the patient's permanent recovery in mind, exclusion of the pylorus after duodenal ulcer was important.

DR. A. V. S. LAMBERT reported a case where the patient, after a long-standing history of gastric disturbance, with pain and hemorrhage, had a gastro-enterostomy done in some western city. This benefited him for a year. He was a man of rather alcoholic tendencies, and a year after the operation he had a sudden attack of syncope, followed by tarry stools. This was followed for a month by bleeding, anæmia, and gastric pain, in spite of medical treatment. An X-ray was taken, which revealed a condition very similar to that shown in the plates demonstrated by Dr. Brinsmade. The X-ray also showed that some bismuth remained in the stomach as long as two hours after a test meal, and that the stoma though large was placed too far from the pylorus.

The patient stated that the original operation was for an indurated duodenal ulcer, and a year later, when the abdomen was opened, it was found that there was a jejunal ulcer alongside of a large stoma, several inches from the pylorus. They thereupon did a Finney operation on the pylorus, and the original gastro-enterostomy opening was left alone. That operation was done six months ago, and the patient had since remained free from hemorrhage and other symptoms. Repeated X-ray plates had shown that the stomach contents now passed almost exclusively through the pylorus, very little passing through the gastro-enterostomy stoma.

DR. KAMMERER, the president, said he had done von Eiselsberg's operation of exclusion five times in the last two years for duodenal ulcers. One case, which was operated on about three months ago, was a man of thirty in whom the speaker, on operation, found a large mass involving the pylorus and the beginning

of the duodenum, evidently an inflammatory deposit about a chronic ulcer. Several months prior to the operation the man had had a severe hemorrhage, and this was followed by another, equally severe, two months after the ulcer had been excluded. There were a few other similar cases on record.

His other cases, Dr. Kammerer said, had done exceedingly well. In some the operation dated back two years, and the patients had remained perfectly well, without any recurrence of their symptoms.

Dr. Kammerer said he could not entirely agree with Dr. Lilienthal that the two-stage operation was indicated in malignant tumor of the stomach. Personally, he had not been very fortunate in attempting to remove a malignant growth after doing a primary gastro-enterostomy, as he found, upon reopening the abdomen, that the tumor had become less movable than it was at the first operation. On one occasion he had been compelled to do a primary gastro-enterostomy and resect the pylorus afterward, owing to the extremely weak condition of his patient, but whenever possible he thought that the complete operation should be done at one sitting.

DR. BRINSMADE said that while on the subject of the inversion of gastric ulcers, he wished to call attention to the fact that the method was not always entirely satisfactory, as demonstrated by one of the cases he had shown at this meeting.

Speaking of the X-ray plates he had exhibited, Dr. Brinsmade said they were shown as evidence of an unsuccessful case, and were intended to illustrate the very point brought up by Dr. Rogers. The stoma was too large. It was made at the most dependent part of the stomach, and the plates showed its condition fifteen months after operation.

DR. LILIENTHAL said that what he had urged was not two operations, but a single operation in two stages, with an interim of perhaps two weeks between them. During the first stage he used no gauze; then there were no adhesions and the second stage was comparatively easy.

TUMOR OF THE CAROTID BODY.

DR. HOWARD LILIENTHAL presented a woman, sixty years old, who was first shown by him at a meeting of this Society in the spring of 1909. At that time she gave the history of having had

a small tumor in the side of the neck for thirty years. During the preceding five years it had increased considerably in size, and during the last year it had grown so rapidly that she became alarmed. The case was diagnosed as one of tumor of the carotid body, the diagnosis being based on the hardness of the growth, its location, the long history and the fact that the speaker had seen and operated upon a similar case some years before. That patient died about two years after the operation of a relapse, with cachexia, but with no evidences of a secondary or metastatic growth. The histological diagnosis in that case, as in the present one, was made in the laboratory of the Mt. Sinai Hospital.

The tumor in the present case was about the size of a hen's egg at the time of the first operation. It was firmly adherent to the internal jugular and to the carotid artery, so that it was necessary to ligate both of these vessels close to the clavicle, and employing them and the freed tumor as tractors, it was possible to shell out the pneumogastric nerve and ligate the external and internal carotid arteries and also the jugular vein in their upper portions, thus completely resecting them. On the day after the operation there was aphasia and well marked right hemiplegia. The left eyeball was soft, and its pupil contracted. In the course of a few days all of these symptoms excepting the contracted pupil had disappeared. The pupillary contraction was probably due to injury of the superior cervical sympathetic ganglion. The aphasia was central. There was no aphonia. In a case reported by Dr. John Chalmers DaCosta before the Philadelphia Academy of Surgery, on May 7, 1906, the diagnosis had also been made prior to operation. DaCosta, too, had been forced to resect the carotid and the deep jugular, and he described the operation as a very dangerous one. His patient was a man fifty-three years old, and after the operation, although there was no aphasia, the tumor being on the right side of the neck, there was hemiplegia, which was very slow to disappear. The carotid body, according to DaCosta, was first described by Mayer in 1833, though its existence was suspected by Haller; and Luschka, in the early sixties, made studies of the gland. It was not invariably present. It was a small gland, varying in size from that of a grain of rice to a grain of corn, and was intimately connected with the carotid at its bifurcation. It did not resemble a gland in structure, and contained many blood-vessels.

Histologically, tumors of the carotid body were similar to the endothelioma or perithelioma of the suprarenal. DaCosta stated that the apparent pulsation in these tumors was transmitted from the arteries. In the case shown, however, it appeared that the tumor itself undoubtedly pulsated. Dr. Lilienthal said he considered the case inoperable, and the patient now showed signs of cachexia. For the past three or four months she had been receiving frequent injections of absolute alcohol into the tumor, but without appreciable effect. Possibly, electrolytic puncture might help.

Dr. Lilienthal said that malignant tumors of this type, including the hypernephromas, appeared to him to strengthen the germ theory of ordinary cancer and sarcoma, the tumors under discussion being perhaps always congenital and remaining merely locally malignant unless actual transplantation should occur through the invasion of a blood-vessel. True metastases through lymph vessels and spaces, as observed in the usual malignant growths, was more likely to be the mode of extension of known bacterial infections.

DR. MORRIS said that endothelioma gave a rather ready response to radium and the X-ray. In one case where he did a gastro-enterostomy to relieve the obstruction caused by a tumor of the pylorus, a section of the growth was taken, which showed it to be an endothelioma. The patient was subsequently X-rayed by Dr. Aspinwall Judd, and under the influence of the rays the tumor disappeared. Whether there was a later recurrence or not Dr. Morris was unable to say, as the patient was lost sight of.

GASTRIC NEUROSIS, WITH X-RAY FINDINGS SIMULATING CARCINOMA.

DR. OTTO G. T. KILIANI showed a number of X-ray plates which had led to the mistaken diagnosis of carcinoma of the stomach. The case was that of a woman, twenty-three years old, who gave a history of gastric disturbance dating back four years, the symptoms consisting of discomfort after eating, nausea, headache, and vertigo. Chemical analysis of the gastric contents showed nothing definite. The case was looked upon as one of gastric neurosis, but as a precautionary measure, a series of radiographs were taken, and in these the contour of the stomach had the typical appearance of a carcinoma of the larger curvature.

Influenced by these findings, the stomach was exposed and carefully examined, and was found to be perfectly normal.

Dr. Kiliani said the only explanation he had to offer for the Roentgen findings which both by himself and by a skilled radiographer were regarded as typical of carcinoma of the stomach, was that this patient was suffering from a gastric neurosis with the production of a large amount of mucus, which prevented the bismuth from coming in contact with the edge of the curvature, and gave a deceptive gastric outline.

Dr. ARTHUR L. FISK said that the case reported by Dr. Kiliani demonstrated the necessity of not giving too great weight to any one sign but that all the symptoms considered together should determine the probable condition.

Tumors when present are generally palpable and obstructive, and food remnants are found in the stomach; if the growth is cancerous there is diminished total acidity, also the free hydrochloric acid is less.

If the symptoms do not correspond with the X-ray findings, the accuracy of these should be questioned.

A logical and judicious consideration of the signs and the symptoms should result in accurate diagnosis.

TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY.

Stated meeting, held October 6, 1913.

DR. G. G. DAVIS, President, in the Chair.

BONE GRAFTING FOR POTT'S DISEASE.

DR. WALTER G. ELMER called attention to the operation of bone grafting for Pott's disease. He said that great credit is due to the originator of this operation, who utilized the spinous processes of the vertebræ as bone grafts from which a firm bridge of new bone was built up, spanning the area of disease and holding the spine rigid. In doing this, the spinous processes are denuded of their periosteum, cut off at their bases and placed like the links of a chain along the tops of the arches. A subsequent operation was suggested which leaves the spinous processes intact, a bone graft from the tibia being inserted in their tips which are split to receive it.

Tuberculosis of the body of a vertebra is a disease which, if untreated, progresses toward destruction of the vertebral body. Even when proper treatment is instituted the disease progresses beyond that time—gradually losing its activity until finally arrested; then the process of repair begins. It may be likened to a ball rolling down an inclined plane—gathering momentum as it descends—and then out onto a level surface, when the momentum is gradually lost and its motion is finally arrested; so with the disease. The level surface is reached at the moment the child's spine is put at rest, but the disease continues to progress to a point considerably beyond this.

An operation therefore which immobilizes the spine and actually adds to its natural strength would appear to be a wise surgical procedure. The new bone which is formed spreads out in a broad compact mass upon the transverse processes and unites the spinous processes.

The new bone grows but if it does not keep pace with the

natural healthy bone of the spine it must exert a corrective influence upon the developing kyphosis.

An operation of this character, requiring, perhaps, forty minutes to perform, and not always upon the most favorable class of patients, must have a mortality. Just what the mortality is cannot be stated. If it should prove to be greater than one per cent. it would make one hesitate to recommend the operation. The operation, however, shortens the treatment and hastens the cure, and must save certain patients that would otherwise progress unfavorably.

A considerable number of patients have now been operated upon in the Orthopædic Department of the University of Pennsylvania—both operations have been employed—every region of the spine has been operated upon—the patients have been children and adults, chiefly children, of course—and in every instance the patients, apparently, have been distinctly benefited.

A support is usually worn for six months after the operation. During the latter part of this period the plaster jacket is discarded and a simple back board of plaster held in place with adhesive straps, or some similar appliance is used.

Dr. Elmer presented two children who had been treated in the Orthopædic Department of the University of Pennsylvania and through the courtesy of Dr. G. G. Davis were now shown.

CASE I.—A boy who had developed a slight kyphosis in the upper lumbar region when brought to the hospital nearly two years ago. He is one of the early cases operated upon. Now a broad compact mass of bone spreads far out on the transverse processes. All other parts of the spine are freely mobile and it flexes readily as he stoops to pick up an object. He walks naturally and is in perfect health so far as one can tell and has been cured for about a year and a half.

CASE II.—A little girl, one of the more recent cases, in which case the feature worth mentioning is the improved line of the spine. No kyphosis can now be seen. Tracings which were made with the lead strip when she was being treated with plaster jackets show quite a little kyphosis in the lower dorsal region—a comparison of those with a tracing made a short time ago shows the difference—this last one shows no kyphosis. The child is strong and healthy and growing, and it is not unlikely that the spine in growing is becoming straighter. She has worn no sup-

port for about two months. Both these children had the bone graft taken from the leg.

TUBERCULOSIS OF KNEE.

DR. ELMER presented a little girl to illustrate the favorable outcome of what promised to be a very discouraging case. Four years ago she was injured and was treated by her physician for tuberculosis of the knee. About eight months later she was admitted to the Jewish Hospital. There was then a discharging sinus above the outer condyle of the femur. A tubercular osteomyelitis involved the epiphysis and lower portion of the diaphysis. The bone was opened on the side and the diseased part cut away and curetted out—leaving a shell of bone. She was treated in bed for three weeks—then sent home wearing a fenestrated plaster cast, high shoe and crutches. She was injured later on by one of her playmates, and the disease then invaded the knee-joint which became distended with tubercular pus. She was re-admitted to the hospital, the joint opened on both sides and drained, and then followed a long course of treatment.

She was kept on crutches and in plaster for one year, then a Thomas knee-brace, then plaster of Paris and the child walking on the limb.

The sinus closed last January. She has worn no support for eight months. She now walks quite naturally and with free and normal motion in the knee-joint and appears to be in the best of health.

DR. GWILYM G. DAVIS queried as to whether the results in cases of bone grafting for tuberculosis of the spine will be permanent. He had recently seen a skiagraph of a case which had been done over a year ago and it showed a distinct shadow of bone lengthwise in the position of the curve; whether this was the original or new bone he could not say, but at any rate there was bone there. The question may be raised as to whether the fixation will remain. The later history of cases, two or three years after the operation, should be known, as to the permanency of the union.

BILATERAL TEMPOROMAXILLARY ANKYLOSIS.

DR. JOHN H. JOYSON presented a woman, aged twenty, who applied for treatment at the Polyclinic Hospital for an ankylosis of the jaws which was of three years' duration. It began as

an arthritis in the course of an illness of acute onset attended by inflammation of most of the joints, including the interphalangeal joints, ankles, knees and elbows. She was bedridden for several months, the polyarthritis lasted a year and a half, was attended by contractures of the arms and legs and finally ended in recovery, except for the persistent ankylosis of the jaws and the lumbar spine.

She has a bony thickening over the lumbar vertebræ with fixation in that region and at one time this locality was the site of considerable pain. She wore a spine-brace for a year but later discarded it. The only disability of which she now complains is the fixation of the jaw.

Examination showed practically complete ankylosis of both temporomaxillary joints with no lateral motion present, and only about one-eighth inch of motion upward and downward, which was practically due to springing of the bone. There was an interval of one-sixth inch between the incisors, the lower being a little behind the upper, and the molars were in contact. She could eat only by breaking or cutting her food into small particles and tucking it into her mouth with her fingers.

An attempt was first made to separate the jaws by means of wooden wedges under general anæsthesia, but nothing was accomplished. Three weeks later Lilienthal's operation was carried out on both sides. Ether anæsthesia, and the preliminary hypodermic administration of morphia to prevent vomiting, were used.

After turning down the zygoma, excellent exposure of the temporomaxillary joint was obtained on either side, and firm bony ankylosis was found to be present. The hammer and chisel were used to cut away the condyles and the neck of the bone. No unlocking of the jaws could be obtained until the second joint had been excised when free opening was permitted. A flap from the temporal fascia was turned back into the joint on each side and sutured between the bones, after which the resected portion of zygoma was replaced and held by periosteal suture.

The patient made a good recovery, although there was slight superficial infection on each side. She moved her jaws well after a few days, and was put on solid diet at the end of a week. It was not found necessary to keep anything between the teeth at any time. She ate an apple twelve days after operation by biting into it, and said she could have done so sooner. When discharged

from the hospital she had a possible separation of seven-eighths of an inch between the incisors, with a strong bite, and good rotary and grinding movement.

Her general nutrition has rapidly improved. She has gained more than 20 pounds, and eats everything.

The advantages of the method of approach in this operation as described by Lilienthal (*ANNALS OF SURGERY*, August, 1911) include a good and easy exposure of the joint and the absence of any danger of injury to the facial nerve.

Dr. Lilienthal has reported four cases, three of them operated upon with perfect success, and the fourth still under treatment.

There is some risk of slight infection which may come from the traumatism of the operation, and possibly through the salivary duct and the parotid.

The method consists of making an incision along the zygoma, beginning just in front of the auricle, carried down to the periosteum. At right angles from this, a second incision runs downward in front of the ear for a distance of an inch and a half and divides only the skin. The triangular flap so outlined is dissected downward and forward. The zygoma is divided by carrying a fine Gigli saw around it in two places, after which it is turned down with the masseter muscle and soft parts attached, including a portion of the parotid gland, and fibres of the facial nerves.

When bony ankylosis exists the condyles and the neck on each side are removed with gouge and curette or with hammer and chisel. Arthroplasty is completed by turning in a flap of temporal fascia.

It is usually advisable to operate on both sides at once when unilateral excision will not unlock the jaws, as a two stage operation doubles the danger from ether vomiting which is always present, and which might result fatally. Lilienthal recommends preliminary starvation and morphia half an hour before beginning the ether,—the preparation which proved successful in this case.

UNUNITED FRACTURE OF THE NECK OF THE FEMUR.

DR. JOHN H. JOYSON presented a colored man, aged fifty-one, who slipped and fell on a level floor, October, 1912. He was unable to stand or walk; was taken to a rural hospital where he remained

for five days, and was then brought to his home in Philadelphia. He received no treatment, but after several months presented himself at the Polyclinic Hospital, disabled and unable to walk without assistance. Examination showed an ununited fracture of the neck of the right femur, with a considerable amount of callus around the fracture and three-fourths of an inch shortening.

An open operation was performed through an anterior incision, the joint opened, a large amount of synovial fluid under tension evacuated, the fractured surfaces freshened and a $2\frac{1}{2}$ inch screw introduced through the great trochanter into the head of the bone.

Primary union was obtained. He now has what appears to be good bony union with an inch and a half shortening and a good functional result. He still uses one cane in walking, but is doing a little light work.

ILEOSIGMOIDOSTOMY (LANE).

DR. JOHN H. JOPSON presented a man, aged thirty-eight, who had suffered for 17 years with abdominal pain and constipation. Illness began rather acutely with what was diagnosed as inflammation of the bowels. Pain increased in severity and six years ago his appendix was removed. He was relieved for a time, relapsed again and in the Spring of 1912, Dr. Jopson operated and found adhesions, perigastric, periduodenal, and generalized throughout the abdomen. Extensive division of adhesions was followed by temporary improvement lasting for eight months, when he again relapsed, and reapplied for treatment in June of 1913. He was obstinately constipated, complained of constant pain in the hypogastric region, and was unable to work at his trade as a paper-hanger.

He was again operated upon in the end of June. Marked perigastritis and pericolitis were present. The small intestines were practically free of disease, their peritoneal coat being in striking contrast to that of the large bowel and stomach. The stomach was much distended.

An ileosigmoidostomy was made according to Lane's technic, except that the anastomosis was made as high in the sigmoid as possible. The colon was not removed. He remained in the hospital about four weeks. He returned to his work a month later greatly improved, and since then he has gained many pounds

in weight. The pains have disappeared and constipation has been much improved. He usually has two or three liquid movements a day, sometimes finding it necessary to use a mild laxative. He considers himself relieved of most of his old symptoms.

THE RELATION OF POSTERIOR SUBLUXATION OF THE SHOULDER-JOINT TO OBSTETRICAL PALSY OF UPPER EXTREMITY.

DR. T. TURNER THOMAS read a paper with the above title for which see the February issue of the ANNALS OF SURGERY.

DR. ASTLEY P. C. ASHHURST said that he had recently seen at the Episcopal Hospital a child of two years or thereabouts, who had been injured in birth; there was complete flaccid palsy of the upper extremity, and *complete loss of sensation* in the limb, and this had persisted unchanged since birth. This child will chew its own fingers, frequently injuring them in this way, and sometimes burning or scalding them.

Again he had recently operated, at the Episcopal Hospital, on a boy of twelve years who presented partial flaccid paralysis of the upper extremity due to injury at birth, the shoulder-joint was almost flail-like, and if his arm happened to get into the position of extension (behind the patient's body), the head of the humerus became subluxated anteriorly, caused him pain, and he had to pull this arm forward with the other hand. There was also persisting paresis of the muscles supplied by the radial nerve. There was no posterior subluxation of the head of the humerus.

Another case was that of a baby with typical "obstetrical palsy" of the arm sent from Dr. Harte's service in the Orthopædic Hospital to the nervous department for examination. Dr. Boyer found reactions of degeneration present, but on account of the extreme youth of the patient it was not possible to determine very accurately which muscles were at fault.

Last winter he saw, at the Episcopal Hospital, two brothers (one about twelve years old, the other about seven years) who had been similarly injured in birth. In both patients there was distinct posterior subluxation of the shoulder, and the head of the humerus could be felt back of the acromion. Typical paralysis was present, but great improvement had occurred since birth.

Last winter he saw at the Orthopædic Hospital a baby only a few weeks old, who had been injured in birth, by attempted but

unsuccessful version. When born the arm was held across the front of the neck, with the elbow highly elevated, the forearm fully pronated, and the palm of the hand looking forward, and being in a position above the opposite shoulder. The limb rebounded to this position when attempts were made to bring it down. The head of the humerus was clearly palpable beneath the spine of the scapula, and in the axilla was a bony prominence, probably the glenoid or coracoid. There was practically complete paralysis. The mother was directed to manipulate the arm daily, and she brought the patient back for observation at frequent intervals at first. The child is now nine months old. Now the head of the humerus stays in the glenoid, and can be felt projecting forward in front of the acromion as is normal; it is not palpable beneath the spine. Great improvement has occurred in the paralysis, and is continuing; only recently there has returned very slight power of extension of the wrist and fingers. Otherwise there is complete paralysis of the musculospiral nerve.

Dr. Ashhurst remarked that it has been maintained by Duval and Quillain (*Arch. Gén. de Méd.*, 1898) that there are no such clinical entities as paralyses due to lesions of the brachial plexus, only two types existing, radicular and terminal, affecting either the spinal motor roots or the nerve trunks below the plexus. It appears to be the contention of Dr. Thomas that nerve lesions of any kind are of extreme rarity, and if not altogether hypothetical at least are secondary in causation and importance to lesions of the shoulder-joint.

The cases he had now cited seemed to him to demonstrate: First, that pure nerve lesions occur (Cases I and II) and may be of much greater importance than any injury to the shoulder-joint even if this is present (Cases III and V); and second, that, as Dr. Thomas has pointed out, posterior subluxation of the humerus is a frequent lesion, often overlooked and perhaps may be the cause of persistence of paralysis (Case IV).

There can be little doubt that surgeons who see many of these cases will have their interest stimulated in the pathogenesis and treatment of the lesions by this further very important contribution made by Dr. Thomas to the surgery of the shoulder-joint.

DR. THOMAS, in closing, said that he did not mean to say that none of these cases of birth palsy were due to rupture of the

brachial plexus but he believed that none of his twelve cases were. He thought it fair to say that most cases are not. There was no doubt in his mind about rupture of the nerves in Boyer's case.

With regard to anterior luxations at birth, he had not seen them. The only autopsy report of a congenital anterior luxation of the shoulder-joint which Stimson could find is one reported in Stimson's book, observed in 1847 by Smith, which was a double anterior dislocation. Stimson concluded that Smith did not have a congenital dislocation in this case, and after reading Smith's report he would agree with Stimson.

CANCER AND PRECANCEROUS CONDITIONS.

DR. WILLIAM L. RODMAN read the Annual Oration for 1913 on the above subject, for which see page 47.

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ORIGINAL MEMOIRS

THE PRESENT STATUS OF BISMUTH PASTE TREATMENT OF SUPPURATIVE SINUSES AND EMPYEMA.*

BY EMIL G. BECK, M.D.,

OF CHICAGO, ILL.

Surgeon to the North Chicago Hospital.

NEARLY eight years have now elapsed since I began to employ the bismuth in diagnosis and treatment in sinuses, etc. During this period a variety of cases amounting now to over 1100 cases have been treated by myself and my brothers, which naturally have given us ample opportunity to give the method a fair test. The experience gained from successes and also failures has taught us valuable points, which I shall now bring before you, in order that they may aid you also in correctly applying this method.

Many of you have no doubt had experience of your own in treating abscesses and sinuses with bismuth paste, and are familiar with the method from the literature. This relieves me in a degree of the necessity of discussing the theoretical side of the subject.

In June, 1906, I demonstrated before the Chicago Medical Society this new method, which consists in injecting the sinuses with a mixture of 33 per cent. of bismuth subnitrate and 66 per cent. of vaseline. This mixture must be sterile and liquefied by heating, so that with moderate pressure it

* Read before the International Medical Congress, London, 1913.

will fill all branches of the sinuses. Radiograms taken of the injected region show in perfect clearness the extent and ramifications of the fistulous tracts, and often lead us to the focus of disease (Fig. 1). A glance at such picture enables us to discriminate between operable and inoperable cases, whereas with the older diagnostic aids, such as the probe or the injection of colored fluids, the operation itself had to be performed in order to determine whether the case was operable or not.

This diagnostic method led to the discovery that the injection of the bismuth paste has a distinct therapeutic effect. This was not fully appreciated until a year later when we observed that the patients on whom we had employed the injection for diagnostic purposes returned to us after months entirely cured. This at once suggested the use of bismuth-vaseline paste for curative purposes, and our expectations were far surpassed when we tried it in a number of obstinate cases.

On January 15, 1908, I brought before the Chicago Medical Society the first fourteen cases treated by this method, ten of which were then cured. Of these fourteen cases, thirteen are now entirely healed, one died in 1910 after sixteen years, suffering with most extensive necrosis of the spinal column.

Soon after my first publication in the *Journal of the American Medical Association* and the *Centralblatt für Chirurgie*, surgeons in all parts of the world began to employ the bismuth paste. Their readiness to give it a trial was partly due to the simplicity of the method applicable to a class of cases for which there was no efficient remedy. Suitable cases for a trial were abundant everywhere, and only too willing to try anything new.

Reports soon began to find their way into literature. Some authors obtained results even better than ours, others were only partially successful, and then in the hands of a few the method was a failure. Considering, however, that 100 per cent. of these cases in which it was tried had already been treated by other methods without success, we must regard

FIG. 1.

Fig I



Network of sinuses originating from hip-joint.

FIG. 2.



Fig. II.
Tuberculosis
of
Ribs.
Back

Tuberculosis of seventh and eighth ribs. Bismuth injected through sinus in sternum.

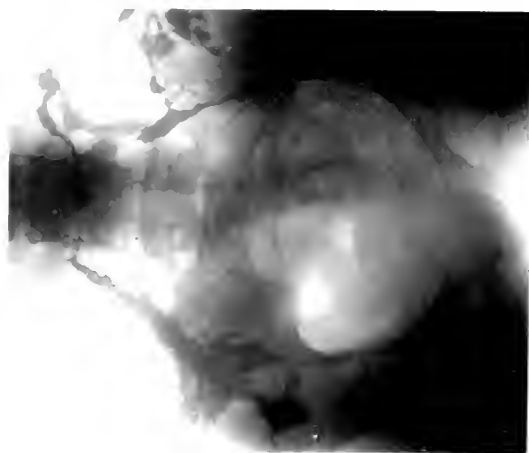
FIG. 3.



Resected ribs showing that disease existed within the cancellous tissue.



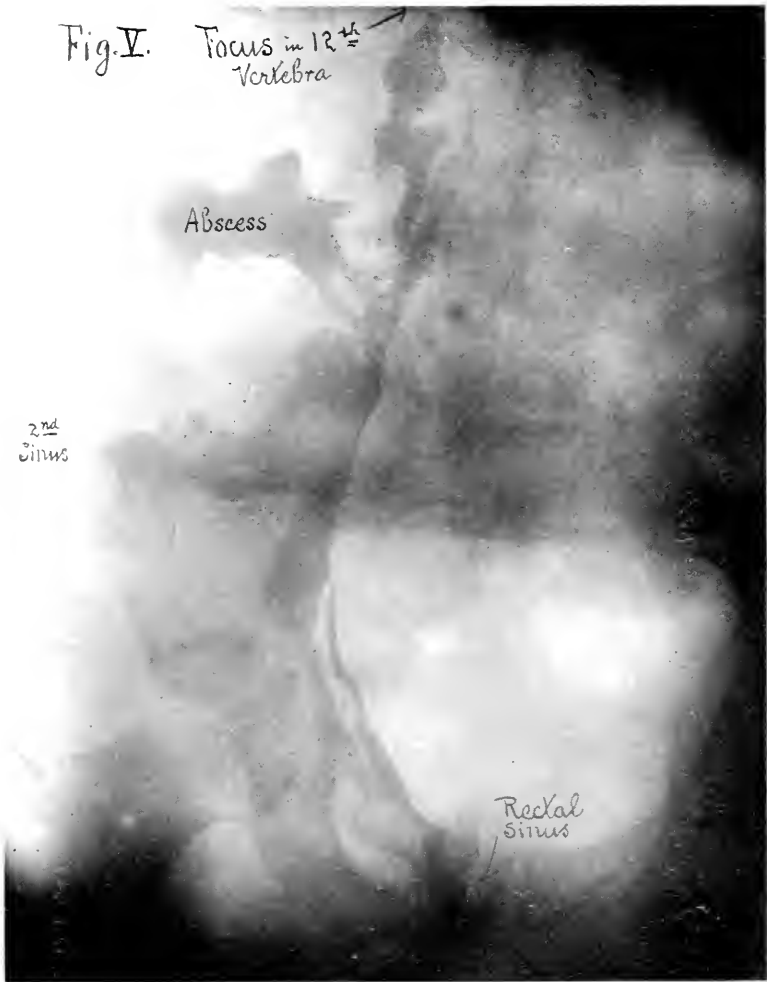




SINUS PASSING THROUGH SPINAL COLUMN.
INJECTED WITH BISMUTH PASTE.

Beck.

FIG. 5.



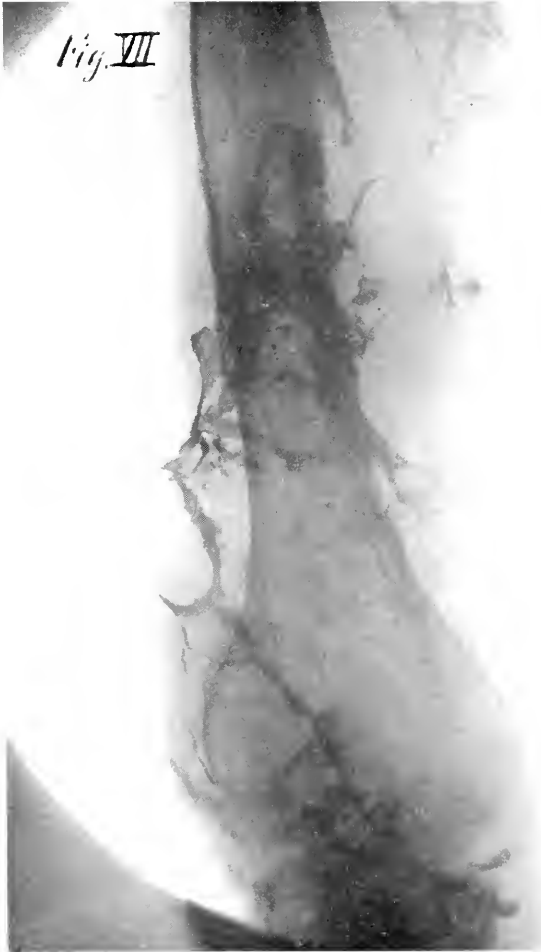
Supposed rectal fistula repeatedly operated, causing incontinence and invalidism disclosed to be tuberculosis of eleventh and twelfth dorsal vertebrae.

FIG. 6.



Hip-joint disease, sixteen years duration, operated fifteen times without success. Injection of paste in 1907, closure in thirty days. No recurrence.

FIG. 7.



Network of Sinuses
of
T.B. of Tibia.
Temur Beaked.
13 Beck

Complexity of sinuses of knee-joint proving the uselessness of probing.

even the smallest percentage of cures in this series as an actual gain. The accumulation of reports in the past five years from all sources indicates that more than 50 per cent. of these apparently hopeless cases were finally cured.

The uses of bismuth paste are threefold, namely:

1. For *diagnostic* purposes, by which I mean for making a correct anatomical diagnosis and tracing the sinus tract.
2. For *therapeutic* purposes in chronic suppurations.
3. For *prophylactic* purposes, which means for the prevention of sinuses.

FOR DIAGNOSTIC PURPOSES.

Its diagnostic value has been acknowledged by all who have employed it. There are recorded in literature from all parts of the world many hundreds of cases in which this method cleared up puzzling conditions. For illustration, I cite here a case which is now under my care.

P. S., forty-one years old, rheumatism at twenty-nine, malarial fever at thirty. Ten years ago he developed a pronounced pulmonary tuberculosis and went to Arizona and gradually recovered from the tuberculosis of his lungs. January, 1910, he noticed a small abscess on the left of his sternum. It was incised and the bone scraped several times. In August, 1911, I removed a part of the sternum to eliminate the focus of disease, but a foul discharge persisted. Another radical operation was performed six months later in Arizona, surgeon resected the greater part of his sternum and four inches of the sixth rib adjoining the sternum. Discharge increased and condition became much aggravated. He returned to Chicago, June, 1913. An injection of paste with the taking of a radiograph for anatomical diagnosis immediately disclosed the cause of failure. The seventh and eighth ribs, at the junction of the lower part of the sternum, were diseased. The radiogram plainly shows that the disease extended through the interior of the two ribs (Fig. 2). A resection of these two ribs proved conclusively the correctness of the diagnosis. The ribs appeared normal on their upper surface, but I was absolutely certain that the disease was located within the marrow of the ribs (Fig. 3), and therefore removed them.

After their removal the suppuration ceased and wounds closed by perfect healthy granulation.

Examples like this explain why surgical operations for these chronic suppurating sinuses often fail. A glance at the radiograph which represents injected sinuses teaches us how irrational it is to attempt a dissection of a net-work of sinuses which lead into an inaccessible region. In the light of these pictures the probing of a sinus will not appeal to those who wish to be consistent (see Fig. 4).

I have previously cited a large series of cases in which incorrect diagnosis of the sinus led to useless and even dangerous surgery, in which, aside from the therapeutic results, the paste cleared up the cause of failure. (I cite here only one typical example.)

Supposed rectal fistula, repeatedly operated causing incontinence, disclosed to be tuberculosis of the eleventh dorsal vertebra.

A. H., fifty years old, was first seen by me in June, 1913. He stated that four years before he had been treated for pararectal abscess, after he had suffered for nearly eight years with what was thought to be rheumatism of the back. The operation resulted in a fistula, fever and emaciation began from that time. He was confined to his bed **nearly** all the time. A second and third operation was performed with division of the sphincter resulting in complete incontinence of the rectum. Another operation was then performed above the crest of the ileum and two more sinuses remained. I saw him in June, 1913, at his home in Canada. He was unable to walk, having been confined to bed for the last fourteen months. July 12, 1913, he was brought to Chicago. The injection of paste as shown in Fig. 5 revealed the true diagnosis. The sinuses with several side tracks reached from the rectum directly into the eleventh and twelfth dorsal vertebræ, where the disease originated. The injection not only cleared up the diagnosis but had a marked therapeutic effect. The rectal sinus closed, and the man gained twenty pounds in six weeks, and was able to walk about five miles each day. He is now engaged in his usual work, but the two sinuses at the crest of the ilium still discharge small quantities of pus.

FOR THERAPEUTIC PURPOSES.

At the present time very few doubt the therapeutic effect of the bismuth paste in old chronic sinuses and empyema.

In our series of cases treated at the North Chicago Hospital we have used the paste in practically every variety of chronic suppurations. We have treated sinuses resulting from spondylitis, hip-joint disease, tuberculous knee, ankle, shoulder, wrist and ribs, osteomyelitis in all parts of the osseous system, including the clavicle and fibula; further, chronic suppurations of soft structures, such as sinuses after extirpation of kidney, broken-down tuberculous glands, rectal fistulæ, and sinuses following laparotomies. The accessory sinuses of the head and the fistulæ of the alveolar process have also been treated by this method by my brother, Dr. Joseph C. Beck. Only fistulæ of the gall-bladder, the pancreas and those communicating with the cranial cavity have, for obvious reasons, not been treated, with the exception of one case of biliary fistula referred to me by Dr. Robert Morris, of New York, in which I tried it and obtained a splendid result. I shall reserve a tabulated report of our series of 1100 for another publication, but our results obtained so far have greatly exceeded those reported in the past.

We have learned from experience, and by improving the technic as well as by avoiding complications, to cope with the most hopeless cases, so that the percentage of complete cures has increased every year.

Statistics.—In order to reach a just conclusion as to the therapeutic results, I do not propose to hold up my own results as a criterion, I prefer to quote the average from the cases recorded in medical literature.

It is impossible to estimate the extent of the use of this method, because the bulk of the cases come into the care of the office or the patient's home, and thus only a small fraction of treated cases are published. Some large hospitals in this country, and clinics abroad, as well as individual surgeons, have from time to time made reports of their experiences, the collective summary of which up to 1913 is as follows:

Name	Number of cases	Percentage of cures
Ochsner, Chicago.....	20, tubercular sinus	55
Ridlon and Blanchard.....	17, tubercular sinus	53
Beck, E. G., Chicago.....	192, collective report	64
Robitecksh, Minneapolis.....	9, tubercular sinus	55
Don, Edinburgh.....	6, tubercular sinus	17
Rosenbach, Berlin.....	4, tubercular sinus.....	50
Dollinger, Budapest.....	16, tubercular sinus	12½
Beck, J. C., Chicago.....	319, accessory sinuses.....	22
Pennington, Chicago.....	17, rectal fistulæ.....	76
Baer, Baltimore.....	12, tubercular sinus	33½
Stern, Cleveland.....	4, tubercular sinus	100
Steinman, Muenchen.....	5, tubercular sinus	20
Bogardus, U. S. A.	1, tubercular sinus	100
Vidakovich, Russia.....	2, empyema	100
Nemanoff, St. Petersburg.....	6, empyema	100
Ochsner, A. J., Chicago.....	14, empyema	85
Beck, E. G., Chicago.....	11, empyema	82
Ely, New York.....	14, tubercular sinus.....	43
Hines, Cincinnati.....	9, tubercular sinus.....	89
Cuthbertson, Chicago.....	1, intestinal fistula	100
Sandoe, Sag., Budapest.....	2, otologii	100
Heitz, Boyer, Morens, Paris.....	11, renal sinuses	73
Zollings, Zurich.....	25, tubercular sinus	54
Schober, Philadelphia.....	5, tubercular sinus	80
Gessner, New Orleans.....	4, tubercular sinus	50
Schmid, Vienna.....	15, tubercular sinus	30
Rivero, Porto Rico.....	8, tubercular sinus	75
Goror, E., Paris.....	2, tubercular empyema	66
Reichelfelder, Washington.....	4, tubercular empyema	75
Brandes, Kiel.....	29, all varieties of sinuses.....	76
Beck, R., Chicago.....	58, alveolar sinuses.....	54
Beck, R., Chicago.....	9, empyema antrum.....	66
Collective reports from 19 dental surgeons in U. S. A.....	39, alveolar sinuses.....	74
Collective reports from 19 dental surgeons in U. S. A.....	4, empyema antrum.....	100

It must be taken into account that this represents a class of cases in which other treatment had previously been applied and had failed, some cases had even passed through a series of as many as twenty unsuccessful surgical operations, often the disease having lasted many years, yes, as many as forty years, as occurred in two of my cases.

An example or two may serve as an illustration of the therapeutic possibilities.

Hip-joint disease of sixteen years' duration. Fifteen operations. Injection of paste. Closure in thirty days.

Miss M. G., aged twenty-one, developed a painful condition

of her right knee and hip at the age of six. For one year she was treated symptomatically, and then a diagnosis of hip-joint disease was made by aspiration of pus from the hip. Incision and drainage (at the time considered the proper procedure) made. Condition was thus aggravated, and after six months of extreme suffering, often requiring chloroformization during dressings, a radical operation was performed, consisting in the resection of the head of the femur. This radical procedure, however, resulted in the formation of many sinuses and the persistence of fever. During the following ten years she submitted to thirteen more or less radical operations, at intervals of from six months to three years, all of which, however, were of no avail. The discharge and pain persisted. The last operation was performed by Professor Senn, in June, 1907. It was the most radical procedure thus far undertaken. Both trochanters were removed, and the acetabulum was thoroughly curetted. The five sinuses, however, kept on discharging pus. In December, 1907, the first injection of bismuth paste was made, and repeated every two or three days, and on January 15, 1908, the sinuses were closed and have remained thus for 6 years. The radiograph (Fig. 6) shows the extreme destruction of the joint, the end of the femur, including both trochanters, having been removed. The rim of the acetabulum is filled with bismuth paste, showing distinctly a collateral sinus.

Causes of Failure.—To explain the varying results among different authors, many factors must be considered. During my visits to various hospitals and clinics in America and Europe, I have had some opportunity to observe why some men have failed to obtain the best results and I shall enumerate the causes which I believe are responsible for the failures.

We must bear in mind that a sinus or fistula is nothing more than a shrivelled abscess or abscesses. No sinus originates by burrowing its channel from one end to another. The focus of the disease is often at a considerable distance from the opening or openings of the sinus. It is, therefore, inconsistent to try to eradicate the suppuration by only dissecting the sinus tracts. With the radiographic reproductions of the

labyrinths of sinuses before us, an attempt to dissect the same borders on the ridiculous (Fig. 7).

To strike at the root of the trouble is the only rational method to pursue. Find the focus from which the sinus originated, eradicate this focus and in practically all instances it will heal spontaneously.

It is, therefore, essential that when a fistula or sinus is injected with bismuth paste, the paste must reach the focus of the disease. If through faulty technic this is not done, one cannot expect results. It is likewise essential that all branches and crevices of the sinuses of the tract should be completely filled at one time. If one misses a part of the tract, the sinuses will continue to suppurate.

My brother Carl and I have treated a large number of cases in which the bismuth paste had been applied by others without success. This gave us the opportunity to study the causes of failure in a variety of most instructive cases. In some of these, the cause of failure could not be explained. The sinuses often healed after our first injection, whereas the same patient had received many injections previously with no result. We could not tell whether faulty technic, unsuitable instruments or improper material had been employed.

In other cases the causes of failure were easily discovered. Aside from the most common cause, namely, the sequestrum, we found foreign bodies, such as in one case a metal probe in the humerus; in another a rubber tubing within the medullary canal of the humerus, accidentally left in years before; then two rubber tubes within an old drained empyema cavity, etc. These were causes which had prevented the paste from obliterating the suppuration. As soon as these foreign bodies were removed, the cure was almost spontaneous.

These are, however, less common occurrences. They do not account for any considerable percentage of failures. From observation, I conclude that the most common cause is the faulty technic and insufficient knowledge of the rules which have been laid down for the treatment. I have been asked innumerable times: "How often do you inject?" The

proper answer to this question would be: As often as you have failed to reach the focus of the disease.

The first injection should produce the desired result. If it does not, then we must assume that the paste has not found its way into all portions of the diseased tract, and we must try it again. It is a safe rule to wait at least one week. If the discharge changes its character from purulent into a serous, and the microscopic examination of a slide and culture shows that the secretion is sterile, we should *not reinject*, since the sinus will heal out within a very short period. If, however, the discharge continues to be purulent, and we continue to find microorganisms in it, then we should reinject at least two times a week. If there is no change within a reasonable length of time, then we should search for other causes of failure.

Only six per cent. of all the cases in our series have finally been given up as hopeless. For obvious reasons we are not to be envied for the class of cases which fall into our hands for this treatment. They constitute the worst scum of surgical refuse, cases in which every sect of medicine, surgery and quackery had had a chance, and after all had failed to cure the sinuses then someone tried the bismuth paste. If this cured the case, all was well, but if it did not, then the case came to us. Nevertheless, out of this apparently hopeless material I am now able to exhibit many most satisfactory results. It is a mistake in giving a method only a superficial trial, to lose patience and subject the patient prematurely to another useless operation. Experience teaches us that operative treatment of this class of cases is highly unsatisfactory; if it were satisfactory, we would not have armies of invalids, with suppurating sinuses, going around from clinic to clinic some for as many as twenty years.

Surgeons all over the world are on the alert and would not permit such unfortunate people to linger in such condition if they knew of a surgical method for its eradication.

FOR PROPHYLACTIC PURPOSES.

By this is meant the prevention of sinuses. We know that the sinuses are the sequelæ of pre-existing abscesses, and therefore, we must begin by treating the abscess in order to prevent the sinus. This procedure consists in the opening of cold abscesses and injecting them at once with a *ten per cent.* bismuth paste, without suturing the opening or introducing a drain. The quantity used depends upon the size of the abscess, but should not exceed 100 grammes, because in these fresh abscess walls, absorption of bismuth is apt to take place more rapidly, and cause bismuth poisoning. The injection acts as a modifying substance, similar to that of iodoform emulsion, and prevents secondary infection. In a series of over 100 cases, in which I have employed it, only one developed a severe secondary infection, and only four resulted in sinuses. (No deaths.) Follins' figures show that 50 years ago, 56 per cent. to 60 per cent. of all psoas abscesses operated upon died from secondary infection. This method is described in detail in the *Revue de Chirurgie*, T. xlii, December 10, 1910.

We have treated with this method 110 cases, and have made the following observation:

(a) That in practically all cases we could prevent a secondary infection.

(b) That the creamy pus upon opening the cold abscess was changed into a straw-colored clear fluid within three or four days after injection.

(c) That 90 per cent. of all cases closed within three weeks after incision and injection.

The preference to the bismuth over other modifying substances was given for the following reasons:

1. The paste is injected through a small incision instead of using a trocar, and thus the possibility of missing the abscess is eliminated.

2. By discarding the aspirating needle the danger of

injuring underlying vital organs or entering blood-vessels is avoided.

3. Through an incision it is possible to evacuate the larger clumps of the tuberculous débris, which could not pass through the aspirating needle.

4. The thick paste within the cavity will allow the escape of secretions along the walls of the abscess, but will not permit the entrance of infectious material; thus secondary infection is prevented.

5. Injections of other modifying fluids must, as a rule, be repeated, while with the paste the first injection usually attains the desired result.

6. The injection of bismuth paste is not painful or irritating. It is injected in a warm, semiliquid state, and remains long enough in contact with the diseased tissues to produce its therapeutic effect. The vehicle (vaseline) does not macerate the walls of the abscess. Toxic effects from bismuth subnitrate can easily be prevented.

DANGERS AND COMPLICATIONS.

The only danger which has been advanced is the possibility of bismuth poisoning. My brothers and myself are fortunate in not having had a single fatal case in our series of cases. We met with the symptoms in one of the first cases of empyema treated, and were able to check the progress and save the patient. This case was reported by me in the *Journal of the American Medical Association*, January 8, 1909, and is the first case on record. I then warned the profession against the indiscriminate use of the paste. It is fortunate that most of these accidents were at once reported in the literature; this has put on guard those who thought that bismuth was an entirely harmless substance. It must have had a very salutary effect, because nearly all the cases of poisoning occurred in the first two years, 1908 and 1909, and the past year only one case is reported, although the bismuth paste is now employed among the majority of American surgeons, and to a large extent abroad.

It is gratifying to know that the poisoning can be prevented, and if it accidentally occurs and is discovered, it can be checked before it causes irreparable damage.

PREVENTION OF BISMUTH POISONING.

The prevention consists of not allowing large quantities of the paste to remain in the body for absorption. Should the symptoms appear, the paste must be removed by washing out the cavity with warm olive oil. The sterile oil is injected and retained for twelve to twenty-four hours, in order to produce an emulsion, which should be withdrawn by means of suction. After its removal all symptoms will promptly disappear. Scraping out the paste with a scoop is a dangerous procedure, because it opens fresh channels for absorption.

To insure success in employing bismuth paste the essential points are summarized as follows:

1. One should make a correct diagnosis by all methods at our disposal and corroborate same with stereoscopic radiographs before an injection is made.

2. Before attempting to employ this method, one should acquaint himself thoroughly with the technic.

3. The proper instruments should be employed in order to carry out the technic correctly.

4. The patient should be kept under constant observation to prevent bismuth intoxication.

5. Examine the secretions from the sinus before the first injection, by slide and culture, and often by the inoculation of guinea pigs; then three days later test the sterilizing effect of the injection.

6. As long as the sinus contains microörganisms it should be reinjected, but if it is found sterile, it should not be re-injected.

7. It is good practice to wait at least one week after the first injection before repeating it.

8. A stereoscopic radiograph of the parts affected should always precede the first injection, in order to detect the

presence of sequestra or foreign bodies. The shadow of the paste might make their presence obscure.

9. Following the injection, a second set of stereoradiographs should be taken in order to make a correct anatomical diagnosis.

10. In case a foreign body or sequestrum is present, the injection is useless, operation the only means.

11. Acute suppurative processes should not be treated with bismuth paste, only chronic suppurations, both tubercular and non-tubercular.

12. Bismuth poisoning may be easily prevented by using only small quantities, or when large quantities are required they should not be retained longer than ten days, and patient should be carefully watched.

13. Fecal fistulæ and other post-operative sinuses are very favorably affected by bismuth paste treatment.

14. A ten per cent. bismuth-vaseline may be used in cold abscess. In practically all instances the secondary infection can be prevented, providing the technic is carefully observed.

THE NATURE OF SHOCK.

ITS RELATION TO ACAPNIA AND TO CHANGES IN THE CIRCULATION OF THE
BLOOD AND TO EXHAUSTION OF THE NERVE CENTRES.*

(From the Laboratories of Physiology and Experimental Surgery of the
University and Bellevue Hospital Medical College.)

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AND

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OF NEW YORK.

It is the object of this paper to present the results of a series of experiments which furnish information regarding the relative etiologic importance of acapnia, of reflex changes in the circulation of the blood and of exhaustion of the nerve centres in shock produced by three methods. Crile has concluded as a result of a long series of experiments that the primary change wrought by all causes of shock is a fatigue of the vasomotor centre. As a consequence of this fatigue there is a continuous lowering of the blood-pressure until the cerebral centres, particularly the medullary centres, no longer receive sufficient blood to enable them to functionate normally, and from this cause, in fatal cases, life becomes extinct.

This theory has received the recognition to which it is entitled by the high character of all the work of its chief advocate. The protocols of his experiment demonstrate the close relation between low blood-pressure and shock. At present the theory is made the basis of a method of anæsthesia which is believed to diminish shock in operations, and is rendered conspicuous by having been christened with a new name.

No one can fail to admit the important association of a diminution of blood-pressure with the onset and development

* Read in the Section on Pathology and Physiology of the American Medical Association, at the Sixty-fourth Annual Session, held at Minneapolis, June, 1913.

of shock. Every writer has felt obliged to admit its bearing on the problem of shock. Nevertheless, a rather large number of writers since the publication of Crile's work have been unable to believe that any of the series of events, including the low blood-pressure itself, which may result in shock is, at the start, a process of fatigue of the nerve centres. Meltzer has discussed the whole question at length in a review of all the more recent theories of the nature of shock. He presents many observations of others and adds the results of his own experiments to show that the primary changes in the human body leading to the development of shock is not fatigue of the nerve centres but an inhibition of their activities. Differing from Crile, he quite justly questions the legitimacy of distinguishing etiologically between shock and collapse.

During the past winter we have performed experiments in connection with the production of shock by three methods. These experiments in agreement with the views of others, particularly of Howell, Porter and Meltzer, demonstrate, first, that a low blood-pressure is an important symptom of shock, but that an animal may pass into shock with a blood-pressure which is still far above a point below which the nervous system fails to functionate normally; and, second, that changes in the frequency of the heart and its output per beat always accompany shock, even in the earliest stages; but that it is very unlikely that changes either in the blood-pressure or in the force and output per beat of the heart are inaugurated by fatigue of the nerve centres. Our experiments indicate that shock in its incipency in some cases is of reflex, and in other cases of local peripheral origin.

From the practical as well as the scientific point of view the causes inaugurating shock are the most important. It matters little that a low blood-pressure may cause the death of an animal already in fatal shock. We wish to know what are the causes leading to shock before the blood-pressure begins to fall, and how to prevent these causes from becoming active.

Yandell Henderson has sought an explanation different from that of all other writers. He concludes from a large

amount of experimental work that acapnia can be one of these causes. He believes it to be the essential cause in shock produced by artificial hyperrespiration and by prolonged exposure of the intestines, and may be a cause of that form of shock produced by severe stimulation of afferent sensory nerves.

In all experiments performed by us, dogs were used. Each animal received 0.005 mg. of morphin for each kilogram of body-weight. Sufficient ether was given during each experiment to produce full anæsthesia.

SHOCK AND ARTIFICIAL HYPERRESPIRATION.

In the first series of experiments that form of shock was considered which was produced by artificial hyperrespiration.

A suitable time after the injection of the morphin the animal was etherized and a rubber tube introduced through the larynx into the trachea. By means of two rotary blowers and an intervening slide-valve which regularly threw first the exhaust of one blower and then the intake of the other blower into connection with the intratracheal tube, air was alternately forced into and sucked out of the lungs. The slide-valve was operated by another electric motor than either of those turning the blowers. Its speed was regular and could be controlled by a rheostat, and the frequency of the interruption of the valve which it operated could be varied as occasion demanded. By means of by-passes in series with the exhaust of the blower used to inflate the lungs, and the intake of the blower used to deflate the lungs, the amount of air used for the artificial inspiration and expiration could be varied at will. In these experiments the intratracheal catheter did not tightly fit the trachea. Provision, therefore, was made for the escape of any excess of air forced into the lungs during the inspiratory phase around the intratracheal tube, and the same factor of safety controlled the expiratory phase. We found, without this provision for a certain latitude in the amount of air used to inflate and deflate the lungs, that sudden death from excessive variations of pressure within the chest could occur. As will be developed, this fact is in accord with our own belief as to the cause of shock produced by excessive artificial respiration.

In four of these experiments which we have performed, the artificial respiration varied from 60 to 70 times a minute, and the lungs were as completely inflated and deflated as is possible with a closed chest. In order to accomplish such a filling and emptying of the lungs at a rate of from 60 to 70 times a minute, the air must be forced into and sucked out of the trachea under considerable pressure. Two of the experiments were continued for three hours and two for two hours. In these experiments the blood-pressure fell 40 per cent. within a few minutes after starting

the artificial respiration and then decreased more slowly to between 40 and 50 mm. of mercury. After the cessation of the experiments, the blood-pressure rose from 60 to 90 per cent. within a few seconds.

The carbon dioxide content of the arterial blood at the end of the experiments was from 38 to 44 per cent. of its original amount. The amounts of carbon dioxide and oxygen were measured in all experiments reported in this paper by the Barcroft-Haldane method. At the end of the experiment the animals were in deep shock. One died the next morning, one in two days and the other two lived three days. None of them died of the immediate effects of the experiment, but from secondary effects. They had recovered from the shock and their lungs at necropsy showed interstitial emphysema. In all these experiments it was found that the amplitude of the pulse and the blood-pressure was proportional to the pressure at which the lungs were inflated and, therefore, to the intrathoracic air-pressure. The amount of shock which was produced was proportional to the length of time that certain pressures, which we may term critical intrathoracic pressures, were maintained. The carbon dioxide content of the arterial blood could be easily reduced to from 40 to 50 per cent. of its original amount within half an hour; but in four other experiments when artificial respiration was maintained for only this short period, we found that no shock resulted. It has been assumed by Henderson that a long-continued acapnia, lasting two to three hours, results in a depletion of the tissues' store of carbon dioxide by osmosis, and accompanying this osmosis of carbon dioxide from the tissues into the blood, water passes from the blood into the tissues. As a consequence, a diminution of the total volume of the blood ensues. The associated general muscular relaxation dependent on the changed chemical composition of the muscles contributes to the diminution of the general blood-pressure by no longer affording the proper support to the veins. Thus the venopressor mechanism is also disturbed and, with it, the proper balance of the distribution of the blood in the body.

In our experiments the force of the artificial respiration necessary to produce acapnia was so excessive and the degree of shock and the change of blood-pressure so closely proportional to the intratracheal pressure that the air-pressures, at which the artificial respiration was given, seemed to us to be the most important factor in the production of shock by this means. We therefore performed three experiments in which the same conditions of artificial respiration were maintained, but with the provision against the loss of carbon dioxide. In all three precisely the same conditions of artificial respiration were maintained as in the first set of experiments, but, by inserting a rebreathing bag in which the expired air was collected and from which that blower was supplied which furnished the

air to the dog's lungs, and supplying to the fresh air required to be added during the experiment a proper proportion of carbon dioxide from a tank, the amount of oxygen in the blood was unchanged at the end of the experiment and the amount of carbon dioxide raised only slightly above the normal. All of these animals presented the same degree of shock at the end of their period of artificial respiration (two hours) as the animals of the first series. In these experiments, also, the shock was directly proportional to the air-pressures used during the artificial respiration.

Clearly, then, the shock produced by artificial hyperrespiration was not due to a diminution of carbon dioxide but to some other factor which is dependent on increased intrathoracic pressure. Of the effects produced by increased intrathoracic pressure, the one first suggesting itself as the most important and, as far as we can conceive, the only one bearing on the problem of the cause of this form of shock, is the interference of the venous return to the heart. By venous return to the heart, not only the return from the systemic circulation is referred to, but also the return from the pulmonary veins. The latter is affected in two ways, first, by direct pressure around the pulmonary artery, and second, on capillaries and veins within the lungs themselves. The pressure on the pericardium required to alter the general blood-pressure is much above that which affects the circulation when applied to the great veins at the base of the heart. This factor, therefore, can be neglected in these experiments. The most direct manner of measuring the effects of increased intrathoracic pressure on the circulation is to measure the output of the heart; and a third series of experiments, four in number, were devoted to this investigation.

The thorax was opened laterally, and a T-tube connected with a water manometer was tied in a small bronchus. The heart was then enclosed in a Henderson's cardiometer in circuit with a recording tambour. The blood-pressure was recorded from the carotid artery. The thorax was then closed and the animal subjected to intratracheal insufflation from an apparatus provided with an exhaust-valve which reduced the pressure to approximately zero from four to twelve times a minute, or

could be made to furnish continuous insufflation. In one experiment taken as an example, with an increase of intrabronchial pressure from 8 to 30 mm. Hg, the blood-pressure sank from 122 to 55 mm. Hg and the volumetric tracings of the cardiometer showed a diminution of cardiac output of 44 per cent. In another experiment the blood-pressure rose 15 mm. Hg each time the interrupting valve reduced the intrabronchial pressure from 6 mm. to 0. These variations of blood-pressure were completed within a few seconds after the change in intrabronchial pressure and could be duplicated at will. A rise of intrabronchial pressure above 8 or 10 mm. Hg always caused a fall of blood-pressure proportional to the rise of intrabronchial pressure.

It is evident, therefore, that excessive intrabronchial pressure, such as always accompanies violent artificial respiration even at from sixty to seventy times a minute, is quite sufficient in itself to account for a continued diminished cardiac output and low blood-pressure.

VENTILATION OF THE ABDOMINAL CAVITY.

We next studied the relation of acapnia to that form of shock produced first by exposure of the intestines to a current of warm moistened air passed over them beneath a celluloid cover, and second, by evisceration and handling the intestines.

A portion of the anterior musculature of the abdomen was excised, the omentum cut away and a celluloid window fitted in place between the layers of the muscles left at the side in such a manner as to completely cover the intestines. A current of warm and moistened air was then passed beneath the celluloid over the covered intestines. The air entered through a tube piercing the celluloid at one end of the abdomen and passed out through an opening at the other end. Aëration of the abdominal cavity under these conditions for a period of three hours produced no shock in one experiment and little reduction of the carbon dioxide content of the blood. Through the celluloid it could be seen that no drying of the peritoneal surface occurred. The intestine remained a good color, and peristalsis was almost absent at the end of this time. The blood-pressure was 163 mm. Hg. The celluloid membrane was then removed, the intestines spread out and the aëration continued for forty-five minutes longer. The blood-pressure was then 153 mm. and the carbon dioxide content of the arterial blood was 38.8 volume per cent. The intestines were then handled and in ten minutes the blood-pressure had fallen to 80 mm., and in twenty minutes to 56 mm. After even ten minutes longer there was 31.6 volume per cent. of carbon dioxide in the arterial blood.

As a check to this experiment another experiment was performed. The abdomen was opened by cutting away the anterior wall. The in-

testines were exposed by cutting away the omentum and warm, moistened air passed over them. A long tube was inserted into the trachea in order to preserve the normal amount of carbon dioxide in the blood. At the end of one and one-half hours the blood-pressure had not changed and the animal was in good condition. The intestines were then handled and in ten minutes the blood-pressure fell from 122 mm. Hg to 60 mm. Hg. The carbon dioxide content was 45.1 volume per cent. In twenty-five minutes the blood-pressure was 46 mm. Hg, the carbon dioxide still undiminished and the dog was in pronounced shock. The sciatic nerve was then stimulated and a rise of blood-pressure to 96 mm. Hg was obtained, showing a strong medullary reaction.

These experiments, investigating the relative effects of aërating the intestines and of handling them, justify the conclusion that the manipulation of the intestines and not a diminution of carbon dioxide is the important factor in the causation of shock accompanying exposure and handling of the intestines. We have been unable to find any record among the experiments of Henderson of the production of shock by aërating the abdominal cavity alone within reasonable lengths of time.

SHOCK AND MANIPULATIONS OF THE INTESTINES.

In attempting to investigate the mechanism of shock produced by prolonged handling of the intestines, we first sought to establish definite controls. After some preliminary experiments we demonstrated that by handling the intestines violently for one hour, with, it should be remembered, complete anæsthesia, a deep degree of shock could always be produced. In some of these animals the degree of handling of the intestines was sufficient to produce actual rhexis from the peritoneal surface. In our subsequent work we attempted to avoid such a severe degree of handling. We aimed to secure a very intense congestion without actual rhexis. We satisfied ourselves that this degree of handling, in two hours' time could be counted on to produce fatal shock.

Having established this fact we next attempted to discover how far it would be possible to resuscitate dogs from a condition of otherwise fatal shock produced in this manner by transfusion from another dog.

Deep degrees of shock were produced by handling the intestines in six dogs, as described before, for two hours. At the end of this time each animal was in a deep degree of shock. Their eyes were immovable in the orbits and drawn down and inward beneath the conjunctiva. They were absolutely irresponsive to sensory stimulation. Their muscles were relaxed, respiration was shallow, the surface of the body cold, and the pulse rapid and diminished in amplitude. In one of the dogs the transfusion was given immediately after the period during which the intestines were handled, in the others it was given at varying intervals up to one hour after the intestines were handled. Recovery from the shock followed transfusion in all of the dogs. In four of them immediately after the transfusion their eyes regained the normal position in the orbit. The recti muscles of the eyes recovered from their previous relaxation. The dogs voluntarily moved their legs and became responsive to external stimuli. Immediately after the transfusion three of them ran around the laboratory so that they were obliged to be tied up in order to keep them confined. Running around seemed to cause them no discomfort whatever. In two of the dogs which were not transfused until an hour after the experiment, and with which the blood-pressure had been allowed to reach a very low point during this hour, the recovery was less complete, though unmistakable. Following this improvement all of the dogs remained for a long time in about the same condition but permanent recovery was never obtained. They gradually manifested signs of increasing abdominal distress, becoming in consequence more quiet, and died some time during the following night. The temporary improvement after the transfusion described was only the well-recognized improvement regularly following transfusion in shock from any cause. Nevertheless we believe that these transfusion experiments on animals in shock from evisceration of the intestines afford information regarding the nature of shock when carefully studied themselves, and when taken in connection with the control experiments and other experiments about to be described.

The first significant fact to note, and one previously emphasized by Howell and Meltzer, is the comparatively high blood-pressure at the end of the period of intestinal manipulation. Only two of the animals had a blood-pressure approximating 50 mm. Hg. In all the other animals the reduction of the blood-pressure had been as follows: from 104 to 90; from 114 to 54; from 119 to 75; from 115 to 46, and from 105 to 80. The same failure of the blood-pressure during the period of the production of the shock to fall to a dangerously low point was noted in the control experiments; namely, from 116 to 84; from 118 to 67; from 110 to 94; from 102 to 90; from 145 to 88, and from 129 to 101. The one animal

which recovered ran around the laboratory in an apparently normal condition with a blood-pressure of 50 mm. Hg.

These facts demonstrate that at the end of the period during which the intestines were handled the nerve centres must have been supplied with sufficient blood to enable them to functionate properly in the absence of any other disturbing factor.

The second significant point was the very rapid recovery by the animal of his normal condition after transfusion. In other words, an animal in a deep degree of shock which our control proved would have certainly died in a few hours' time with a progressively falling blood-pressure, and in a number of instances with a blood-pressure which had already shown the first steps of this progressive fall, could immediately be resuscitated by transfusion. This rapid recovery precludes the idea that the other disturbing factor to which reference has just been made was an exhaustion of the nerve centres. We cannot conceive of an exhausted centre recovering so quickly. The fact that in our experiments the dogs spontaneously got up and played around and responded normally, as they did, to whistling, indicates that their cortical centres had not been exhausted by sensory impulses. There is no reason to assume that these impulses evoke a greater response in the medullary centres than in the cortical centres. Our deduction, therefore, that the medullary centres were not exhausted or even fatigued is justified. We draw no distinction except in degree between exhaustion and fatigue.

This conclusion is in accord with the results of Porter's experiments which furnish strong evidence that the medullary centres are not exhausted in shock. Porter obtained in numerous experiments a greater percentage rise of blood-pressure by stimulating the sciatic or vagus or splanchnic, or a greater percentage fall by stimulating a depressor nerve after the blood-pressure had been reduced in shock than before the shock had been produced. With a low blood-pressure the same strength of stimulus would probably be more effective both because the vessels may be dilated and because their walls

meet less resistance during contraction. Nevertheless, the absolute rise or fall in Porter's experiments was very great and the experiments furnish strong evidence of the absence of fatigue in the primary stages of shock.

In one experiment we have confirmed the results of Porter's work. A dog was thrown into deep shock by one and one-half hours of violent artificial respiration. On afferent stimulation of the vagus, or sciatic, or stimulation of the splanchnic, a percentage rise of blood-pressure of almost 100 could be obtained. The absolute rise was practically the same as at the beginning of the experiment before the shock had been produced, namely, 30 mm. Hg.

Those who have explained shock as primarily an exhaustion of the nerve centres assume that the blood-pressure in an unconscious animal falls because the medullary centres respond to afferent sensory stimuli and thus dissipate their energy. Numerous experiments have been reported by others in which animals have been thrown into deep shock by prolonged crushing, tearing, and electrical stimulation of sensory nerves. The results of these experiments have been interpreted as demonstrating the power of prolonged and strong afferent stimulation to exhaust the nerve centres. They have been used to explain the shock following serious injuries or operations and of the various methods of producing experimental shock. If, however, these results are used to interpret other forms of shock, they should parallel, particularly as regards time, the actual conditions of the accidents, operations or experiments which they are used to explain.

We have performed experiments of this kind. The animals have received the usual dose of morphin which has been used in all the work presented in this paper. They were then etherized. The sciatic and brachial nerves were dissected out and a strong faradic current applied for two hours to the nerves. Much tearing and crushing of the nerves was incidental to the experiments. During the period of stimulation the medullary centres were certainly active and presumably dissipating energy. This was proved by the hyperpnœa and rise of blood-pressure maintained during the experiment. As soon as the stimulation was discontinued there was a definite fall of blood-pressure, never, however, to a degree which either indicated shock, or could be of any significance in its pro-

duction. The blood-pressure averaged, for instance, at the start of the experiment, during the period of stimulation and after the latter was discontinued respectively 150, 120 and 110 in the first animal; 90, 120 and 100 in the second; 130, 176 and 140 in the third, and 96, 116 and 74 in the fourth.

These dogs required considerable ether, which regularly lowered the pressure each time it was applied. At the end of the experiment all four dogs recovered promptly. Immediately after the experiment the frequency and amplitude of the pulse was good. It compared favorably with that at the beginning. In one hour's time one of the dogs responded normally to his environment; the other three in four hours' time.

There was certainly little difference in this manner of recovery from that which would be presented by another animal which had received an equal amount of morphin and ether.

These statements are emphasized by the differences presented by animals in which the same prolonged severe stimulation of the sciatic and brachial nerves was conducted after the animal had lost the power of controlling his blood-pressure by a preliminary division of the great splanchnic nerves. Three of these experiments were performed. In one animal at the end of fifty minutes' stimulation the blood-pressure had fallen to 14 mm. Hg, death following a short time later. The second withstood a continuous stimulation for two hours; at the end of this time the blood-pressure was 77 and the animal was in deep shock; in three hours' time he was in still deeper shock and he was killed in five hours' time. The third animal recovered from the immediate effects of the experiment.

The relation of diminished blood-pressure to the production of shock in association with the stimulation of sensory nerves was intensified by bleeding the dogs after the splanchnics had been divided. One of these experiments was performed after division of both splanchnics, 200 c.c. of blood were withdrawn, reducing the primary blood-pressure from 152 to 70. The sciatic and brachial nerves were then stimulated as in the preceding experiment. The animal died in deep shock before the conclusion of the experiment.

In four other experiments dogs were bled until the blood-pressure fell to a degree comparing favorably with the fall produced by dividing the splanchnics and the sciatic and brachial nerves were then stimulated for two hours. All four

of the animals developed deep shock; one of them recovered with the aid of an infusion and was alive the next day; another recovered spontaneously, though he did not stir when disturbed; another died during the experiment from excessive anæsthetization, and the fourth succumbed from the experiment. On the other hand, animals subjected to similarly caused reduction of blood-pressure and equal periods of anæsthetization by ether, but not to the prolonged sensory stimulation, suffered from a degree of shock which we were unable to distinguish from that of the stimulated animals which were similarly bled. It must be remembered in this connection that the latter required more ether. We have performed three such control experiments and are satisfied as to the truth of this statement.

As soon, however, as the animal's blood-pressure was reduced and the animal was deprived of his power of compensating for lowered blood-pressure by paralysis of the splanchnic area, serious shock developed but always in proportion to the diminution of blood-pressure and not greater than in animals in which the blood-pressure was reduced to a similar degree by hemorrhage alone.

In shock produced by prolonged handling of the intestines it seems that much less severe sensory impulses can be present than occur in stimulation of the sciatic and brachial plexus for the same length of time. Consequently, if sensory impulses in an unconscious animal were not effective in producing shock by causing exhaustion of the central nerve cells in the absence of vasomotor control, it is not likely that they are the important factors in the production of shock by prolonged handling of the intestines. Simple division of the splanchnic, as we ourselves have also experienced, does not in itself result in a lowering of the blood-pressure sufficient to produce shock. Within the time limit which we have adopted in these experiments, which is quite sufficient from the practical point of view of the operating surgeon, the exhaustion of the nerve centres by afferent stimulation of sensory nerves is a wholly negligible factor in the production of shock.

CAUSE OF SHOCK PRODUCED BY MANIPULATION OF THE
INTESTINES.

Returning again to the interpretation of the experiments in which shock was produced by prolonged handling of the intestines and in which attempts were made to resuscitate the dogs by transfusion, the quick recovery precludes the idea that the nerve centres had been exhausted. It does not, however, negate the possibility of the condition of the animals at the end of the period of intestinal handling being due to cerebral anæmia in combination with the anæsthesia which had been used. While the blood-pressure was still far above a level which would prostrate an animal wholly out of anæsthesia, there was little difference in the condition of these dogs and similarly anæsthetized dogs whose blood-pressures had been reduced to a similar degree by hemorrhage. Cerebral anæmia, however, is a far different condition from exhaustion of the nerve centres, a state demonstrated to be absent, as we have repeatedly emphasized, by the rapid recovery after transfusion.

But as has been stated, with the fairly high blood-pressures recorded in these experiments cerebral anæmia could have contributed little to the degree of shock exhibited by the animals. Many facts indicate that coöperating with the cerebral anæmia, inhibitory impulses are important causes of the animal's condition at the end of the period during which the intestines are handled. On the cessation of the handling there would be a return of a reflex response of the animal indicating semiconsciousness. An immediate relapse into an insensitive comatose condition could be produced by continuing the handling. The blood-pressure usually fell when the handling was stopped and rose again under the stimulus of handling, though this was not a constant effect. We know that afferent impulses of possibly an inhibitory nature are present. It is due to them that these experiments of evisceration and intestinal manipulation may be performed at times without the continuous use of a specific anæsthetic other than morphin and the preliminary anæsthesia, and yet without *any* evidence whatever of feeling on the part of the animal. There

is no physiological reason for distinguishing between shock and collapse. The latter condition is entirely due to inhibition. Howell and Meltzer have presented additional evidence that inhibitory impulses are important factors in this stage. They unquestionably are responsible in the beginning of the experiment for the onset of shock and the first fall of blood-pressure. If they are then operative they must continue to be during the whole time during which the intestines are handled.

Following the period during which the intestines were handled in those animals in which the shock was produced for control purposes and which were not therefore transfused, there occurred a progressive fall of blood-pressure within the next few hours until death occurred. The progressive fall was often initiated by a considerable drop at the start. This progressive fall was unquestionably due to bleeding into an absolutely paralyzed splanchnic system. During this period we have found that stimulation of the splanchnic nerves produced no rise in blood-pressure, or change in a plethysmographic tracing measuring the amount of blood in the splanchnic area. There were even no indications of blood-flow through the intestinal vessels.

The local peripheral character of this vascular paralysis has been clearly shown by two experiments. A coil of intestines was protected in a plethysmograph during a period of handling of the intestines for one hour and one and one-half hours. The splanchnic nerve was stimulated and the diminution of volume within the plethysmograph recorded before and after the period during which the intestines were handled.

The protected loop and kidney showed a marked change in volume both before and after the period of intestinal manipulation, while after this period a loop of the handled intestine showed no change.

There can be no question therefore about the extreme paralysis of the splanchnic area after two hours' handling of the intestines. There is an absolute paralysis of every tissue of the intestines, of the muscles, of the intestinal walls and of the arterioles. There is an absolute abolition of all reflexes. The great means by which vasomotor changes in the body are

possible, that which the vasomotor centre uses to produce its rise and fall of pressure and without which it is powerless, is hopelessly unavailable.

The amount of blood which this area will contain is well illustrated by a number of experiments which we performed, in which during the period of handling the intestines, the brain of the same animal was supplied with blood from the carotids of another dog, and in one case from the carotids of two other dogs. Before the intestines were handled, an anastomosis was made between the carotids and external jugular veins of the donor and the recipient, which was to be shocked. The purpose of these experiments was to discover whether or not any diminution of shock could be obtained by supplying the dogs being shocked, with blood from a presumably normally beating heart, thus eliminating the small fall in pressure occurring in the other transfused dog, during the experiment. In general the dogs gave the same result as the dogs transfused at the end of the experiment. The main purpose of the experiment was defeated, however, by the fact that the splanchnic area of the recipient during the period in which the intestines were handled drained off so much blood from the donor and in one case from two donors, that the blood-pressure of all donors in the three experiments fell to a serious degree, so that at the end of the experiments the donors no longer supplied the brain of the recipient with blood under good pressure, and were themselves in a serious condition from exsanguination.

Animals shocked in the manner described are deprived of all vasomotor control solely because of a local peripheral paralysis of the splanchnic area. It is as though the branches of their mesenteric arteries emptied into a large reservoir with perfectly flaccid walls, into which they bled to death. The aptness of the comparison of the splanchnic area to a flaccid rubber bag is made more apparent by pressure on the abdomen. The blood-pressure can be raised at will by this procedure. The explanation of the secondary shock developing in the transfused animals, the intestines of which are paralyzed from one end to the other, introduces very complex questions which

are not concerned in this paper. Suffice it to say that the animals remained in good condition with high blood-pressure in one case—the only dog watched till death—for twelve hours, and that they rather suddenly passed into a moribund condition.

CONCLUSIONS.

Our conclusions, which we hope to support by more numerous experiments, and by reporting them in greater detail in the future than has been possible in this paper, are as follows:

1. As severe a degree of shock may be produced by artificial hyperrespiration, and by handling of the intestines when provision is made for keeping the carbon dioxide content of the blood high, as when it is allowed to fall to 40 or 50 per cent. of the normal.

2. Shock produced by artificial hyperrespiration is due chiefly to a long-continued, mechanical interference with the return of the blood to the heart.

3. There is evidence that the early stages of shock produced by evisceration and handling of the intestines is due to inhibitory afferent impulses.

4. At the end of the period during which the intestines were handled none of the animals' nerve centres were exhausted.

5. By such handling of the intestines a complete splanchnic paralysis of local peripheral origin is produced, and it is this paralysis which causes the subsequent fatal fall of blood-pressure and not exhaustion of the nerve centres.

6. In the presence of a good blood-pressure and unimpaired vasomotor compensatory mechanism, prolonged afferent electrical stimulation for two hours will not produce shock or exhaustion of the nerve centres.

7. If trauma to the sensory nerves is a factor in production of shock in an unconscious animal, it is wholly subsidiary to other factors, and it is questionable whether it was apparent in our experiments even when these other factors had rendered the nerve centres more vulnerable by toxic influences, as ether, or by a fall in blood-pressure.

8. The all-important factor in the development of shock, in so far as the forms which we have studied may represent shock in general, is loss of vasomotor control. It is, at least, the impossibility of regaining this control after it has reached a certain degree which determines the failure to recover. The mechanism of this loss and its maintenance is important. The loss of control and its maintenance is never caused by acapnia or central nervous exhaustion, but, aside from afferent impulses more especially splanchnic sensory impulses which may have initiated the shock and contributed to it, the loss of control was always due to local peripheral causes which in our work were mechanical obstruction, loss of blood and trauma to the viscera.

The practical conclusions from these observations emphasize the necessity, in attempting to prevent shock, of providing against a fall of blood-pressure and local trauma, particularly within the abdomen, as the most important of all precautions. The truth of this statement at present is so generally acknowledged that it is almost trite to make it. Nevertheless the conclusions, indicated by the experiments in which unsuccessful attempts were made to produce shock by trauma to peripheral sensory nerves, will not be generally accepted. They directly contradict grounds on which the method of anæsthesia known as anoci-association is based. We appreciate that our experiments are few. Nevertheless, a study of their details demonstrates that their results were decisive and that severe trauma both electrical and mechanical of peripheral somatic nerves in an unconscious animal within reasonable time limits did not result in either a reflex fall in blood-pressure or exhaustion of the nerve centres. Its influence as a cause of shock at least in so far as the three forms of shock which we have studied may serve as examples of shock in general is so small that it may be practically neglected. In this connection it must be remembered that shock following burns is toxic in its nature.

However valuable the blocking of sensory nerves during operation may prove, the explanation is not to be found in the protection which it may insure against fatigue of the nerve

centres, certainly within the time limits of the usual operation. It is doubtless a wise precaution, on account of the more complicated manner in which reflexes may be modified in the human being than in animals, to block the larger trunks of the sensory somatic nerves when these must be divided. Clinical experience certainly teaches that it is most desirable to block the sensory splanchnic nerves when their trunks or more particularly the region of their plexuses must be subjected to trauma. Such blocking will often spare a patient reflexes which may seriously lower the blood-pressure. But the harmful effects, if it persists, is not due to fatigue of the nerve centres but entirely to reflexes and peripheral changes which may be either secondary to them or the result of other local peripheral causes or both. It is equally important to recognize that vasomotor control may be impaired or lost by peripheral injury alone. The central mechanism seems capable of outlasting the peripheral mechanism every time.

The necessity of guarding against loss of blood is self-evident. Of equal importance is the selection of an anæsthetic which, aside from any consideration of toxicity, does not reduce blood-pressure. Ether does not always fulfil this condition. Clinically and experimentally, unless administered with the greatest care, it strongly reduces the blood-pressure. We have numerous illustrations of this fact among our tracings and are disposed to attribute much of the shock of long operations under ether to this fact and to its toxic effect on nerve tissue and the glandular organs. Nitrous oxide does not possess this disadvantage and is also much less toxic. Crile has in no instance shown his keen appreciation of those factors which make surgery more successful than in his advocacy of nitrous oxide anæsthesia. If the general blocking of sensory nerves only increases the efficiency of nitrous oxide anæsthesia it is for this reason valuable. Its effect in eliminating harmful reflexes caused by trauma, particularly in the region of distribution of the splanchnic sensory nerves, has been explained.

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THE DIETETIC TREATMENT OF GANGRENE IN DIABETES MELLITUS.*

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THE purpose of this paper is to call attention to certain surgical conditions to which diabetic patients appear peculiarly prone and, since the usual operative procedures are notoriously unsatisfactory in their ultimate results, to draw attention to some factors which we believe are, in part at least, the cause of the failures, and to suggest a different mode of treatment and emphasize for these cases the importance of a proper diet. The conditions referred to are those changes which take place in the extremities, usually in the toes or feet, and which are classed as diabetic gangrene and more properly spoken of as gangrene in diabetics. The following histories will show that these are not always cases of gangrene, though often considered as such, but simply infections which run a course rendered peculiar by having occurred in diabetic subjects.

The surgeon frequently recommends immediate amputation in cases in which there is gangrene of a portion of the toes or foot and a pronounced interference with the circulation as evidenced by stasis, congestion, and hyperæmia of foot or leg. Too often the surgeon's attitude is that the treatment of diabetes is not within his province, and this serves as a cloak for his ignorance of what is a proper diet. If any one hopes to perform successful surgery on diabetic individuals it is absolutely necessary to treat their diabetes and this is best done by supplying a suitable diet. With the possible exception of the alkalis to combat acidosis the use of drugs is of no value.

The salient facts can be best set forth by the histories of the following cases:

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CASE I.—Admitted to the service of Dr. Charles H. Peck, at the Roosevelt Hospital, suffering from what was spoken of as “diabetic gangrene” of the foot. The patient, a man, had had diabetes mellitus for several years but had never had any proper treatment. Six weeks before admission a corn on the fourth toe of the right foot became infected. The infection developed into a cellulitis and gangrene of the fourth and fifth toes, and they had sloughed off prior to admission. On entering the hospital the patient was very ill. Temperature 104.4°; pulse 120. Urine contained 7.1 per cent. of sugar and showed marked reaction for acetone and diacetic acid. The foot and leg were discolored and cold and the circulation barely perceptible. There was a marked degree of cellulitis and a collection of pus on the dorsal and plantar surfaces of the foot. The wounds were unhealthy and the sloughing tendons and strands of fascia were bathed in pus. The second toe was gangrenous and the line of demarcation was not clearly defined but merged into the surrounding cellulitis. At first amputation seemed to be unavoidable, but as the urine contained large amounts of sugar, and also gave a strong Gerhard’s reaction, an extensive operation under a general anæsthetic was believed to be of hazardous outcome, because of the danger of coma. Accordingly the second toe was snipped off with scissors and under local anæsthesia suitable incisions were made to drain the pockets of pus on the dorsal or plantar surfaces of the foot, and sloughing tendons and pieces of fascia were pulled out and removed. The wounds were loosely packed with gauze tape, soaked in formalin, and a wet dressing of formalin applied to the extremity as high as the knee. The patient was then given a proper diet and was not sent to the ward and placed on “diabetic diet,” which in most institutions means a supply of nourishment selected by the nurse, which is said to be free from “sugar.” Oh that expression “diet free from sugar”! It is in most training schools almost as sacred as that other shibboleth, “peptonized milk by the cold process” and it is a brave surgeon indeed, who has the temerity to suggest that neither of them serves his purpose. This patient was placed on a suitable diet in the hope that the acidosis might sufficiently diminish to permit of the amputation. In the course of a few days not only did the ketonuria disappear, but the sugar excretion fell off markedly also and the foot and leg rapidly returned to

normal. The infective process diminished, the temperature fell to normal and the wounds under daily dressing healed slowly, the sloughs separating and granulations of a healthy character soon closing the wounds. At the end of a month the urine was free from sugar, acetone and diacetic acid, and the patient left the hospital with wounds healed, having escaped amputation and with his diabetes much improved. He continued on a strict diet; his diabetes was held in check until he died of cerebral apoplexy eighteen months later.

CASE II.—A Jewish woman, fifty-one years old, whom one of us (Dr. Foster) had seen several times in consultation. She loved food and especially sweets, detested dietetic restrictions and pretty well ignored her medical advisers. In June, 1912, an acute inflammation of one of the great toes appeared. The slight swelling, redness, and heat in this location, together with the pain, at first suggested gout. After a week, however, the color began to change to a livid hue which later became purplish. The increased heat disappeared and the toe grew colder than the others up to midtarsal joint, and insensitive to touch, although still somewhat painful. There was evidence of marked arteriosclerosis of the radial arteries. The condition was pronounced gangrene and operation advised. The diet had been largely of carbohydrates during the time when the gout theory of causation was entertained and the urine averaged about 200 grammes of sugar *per diem*, there was, however, no evidence of acidosis. It was determined to give diet a trial before proceeding to radical measures, and a competent nurse was put in charge. A strict dietary was carried out for three weeks before the urine was rendered sugar free. During this time the toes did not notably change either for better or worse; but after the urine had been sugar free about a week, the color of the toes began to fade, becoming white and finally normal flesh color. At the same time sensation and warmth slowly returned until a complete recovery was made. This patient remains well although the diet is only an awful memory and the urine contains sugar.

CASE III.—A man fifty-two years old, was admitted to the service of Dr. Joseph A. Blake at the Presbyterian Hospital, with the following history:

The patient remembers no illness prior to one year ago when he had a small blood blister on the fifth toe of his left foot. This

FIG. I.



Case III. Note calcification of dorsalis pedis artery, marked periostitis of third and fourth metatarsals, and osteomyelitis of fourth metatarsal and phalanges of fourth toe.

broke and as it had not healed in three weeks a physician was consulted, who examined the urine and found it contained sugar. The terminal phalanx became gangrenous and six weeks later was removed under local anæsthesia. The patient was then placed on a general diet in which the sugar was restricted and for eight months had no further trouble. Fortnightly examinations of the urine showed 1.3 to 1.6 per cent. of sugar. At the end of eight months, that is two and a half months prior to admission, he noted another blood blister on the fourth toe of the same, the left, foot. Several weeks later a small piece of bone was discharged from the ulcer after which the wound healed. A superficial ulceration then appeared at the base of this toe on its plantar surface. This gradually increased in size during a month and a half until it extended on the plantar surface of the foot as far as the first toe. The patient stated that up to a month previously he had attended numerous banquets and did not restrict his diet. The sugar in the urine ran as high as 2 per cent. During the month prior to admission he had been on what he called a milk and egg diet almost exclusively with rarely an oatmeal day, and the sugar in the urine had averaged about 1 per cent. He had also been compelled to arise several times at night to pass his urine. He thought the amount secreted increased above his former daily average of two litres. His temperature during the month prior to admission averaged between 98° and 100°. His appetite was poor. Bowels were constipated and moved only by taking salts. He never had great thirst and did not lose weight, his average being about 288 pounds. He had no skin lesions and no respiratory symptoms. On admission there was a marked degree of cellulitis in the left foot and leg, with redness, swelling, pain and tenderness extending above the ankle. There was a sinus on the plantar surface which was lined by sloughing tissue and from which a small amount of pus with foul odor exuded. The sinus led to bare bone.

The X-ray (Fig. 1) showed a pronounced degree of necrosis and destruction of the fourth metatarsal bone and the first and second phalanges of the fourth toe. There was also evidence of a marked periosteal thickening of the shaft of the third and fourth metatarsal bones. There was evidence also of an osteoporosis in the bones of the other toes. A portion of the first and all the second and third phalanges of the fifth toe were missing. There

was calcification of the dorsalis pedis artery, plainly shown as a shadow between the first and second metatarsal bones.

The urine on admission was: total quantity, 1515 c.c.; sugar 3 per cent.; glucose 45.45 grammes; acetone moderate reaction; diacetic acid, faint trace; total nitrogen 12.41 grammes; ammonia nitrogen 0.89 grammes. The kidneys excreted 64 per cent. of phenolsulphonthalin in two hours. Although amputation of the foot seemed to be the only thing to do, it was determined to delay as it would not increase the danger to the patient and a trial of suitable diet was advised.

This patient had practically no ability to utilize any carbohydrate; and ingest of gms. 20 of starch was followed by the excretion of gms. 19.8 of sugar and it required three weeks before a sugar-free urine was secured. In this interval, however, the assimilation limit had been raised appreciably as was evidenced by the excretion of from 3 to 6 grammes of sugar after ingesting 20 grammes of starch. At first there was no evident improvement in the foot, but after two weeks a rather sudden turn for the better occurred and this was coincident with a marked return of the patient's strength and well being. Large pieces of plantar fascia came away as sloughs, the circulation in the foot improved slowly and the sinuses became lined with healthy granulations which subsequently healed, and at present he is walking about and reports that he feels "perfectly well." The urine now remains sugar free, although the present diet contains 160 grammes of starch.

The conditions illustrated by these cases raise an interesting pathological question. In the proper meaning of the term this morbid process is not a gangrene; that is not conceivable in the light of ultimate restoration to normal, and yet the condition cannot be differentiated from some cases of gangrene, as there is present a stasis of the circulation which is almost complete.

Many theories have been advanced as to the nature of the process and its underlying causes. There seem to be several factors, all or any combination of which may be present in a given case. There is, we believe, an infection with micro-organisms in every case and there is no specific organism but the common pathogenic forms. In addition to this there may

be marked arteriosclerosis, as in our third case, or a marked alcoholic diathesis, as in our first case. We believe that in certain cases there is present a process analogous to Raynaud's disease as suggested by the second case. Several considerations suggest that it is possibly the increased amount of sugar in the circulating blood which may have reduced the resisting power of the cells. If the last hypothesis be correct it would explain the amelioration of symptoms following successful dietary regulation, since this regulation lowers the percentage of blood sugar; which is its ultimate object.

It is not our contention that every case of "gangrene" in a diabetic patient is of the type here described. There may occur the "fulminating cases" in which high amputation is clearly indicated. But it is rational to give each case as thorough a course of dietary treatment as possible, especially as the results of surgical treatment are most unsatisfactory.

We wish to give the principles of the proper method of feeding these patients and will go somewhat minutely into the dietary.

What this dietetic regulation should be in a given case depends of course upon the type of the diabetes. The principle involved is the same in all. Excretion of glucose in the urine is purely an overflow of excessive blood sugar. Normally the glucose content of the blood is not above 0.1 per cent. In diabetes, however, it is often three or four times this, or even more. The kidneys do not hold back this excess, hence glucosuria. The object of dietetic treatment is to reduce the blood sugar to something near the normal, and the available measure of success in this attempt is the urine. Hence it follows, no diabetic is to be regarded as successfully treated so long as sugar is excreted.

The means at our command of combating this disorder are purely dietetic. It is necessary to restrict the carbohydrate ingest to an amount that is completely utilized by the patient. At the same time we have to remember that total withholding of carbohydrate for more than a few days at a time may also lead to injury to the patient. The problem then is to find the amount of starch to give.

First, with regard to those patients who present no evidence of acidosis, the urine gives no reaction with ferric chloride (Gerhardt's test). These cases may be divided for our convenience into classes: (1) Where the urine becomes sugar free quite promptly after restriction in carbohydrate; (2) where the urinary sugar falls to trifling amounts, 1 to 5 grammes per day, on restriction of starch, but fails to disappear completely on this diet. In both of these classes, without evidence of ketonuria, the diet may be reduced at once to very small amounts of carbohydrate by using meats, eggs, fats, and vegetables that contain little starch. The foods that are available for this diet make up Table I.

TABLE I.

Breakfast¹: Eggs, chops, broiled chicken, fish (fresh, salt or smoked), ham, bacon; tomatoes, onions, mushrooms (broiled or fried); coffee, 1 tablespoonful cream, saccharine to sweeten.

Lunch: Clear meat broths, meat of all kinds, game, poultry, fish; green vegetables, served hot with butter sauce, spinach, Brussels sprouts, string beans, asparagus, artichokes; salad of lettuce, endive, cucumber or tomatoes, with oil and vinegar, and any kind of cheese.

Dinner²: Clear broths, *e.g.*, consommé; meats same as lunch; artichoke root as substitute for potato, cabbage, asparagus, spinach, string beans, served hot; gelatine jellies and custards sweetened with saccharine; nuts of any sort, except chestnuts. Black coffee (claret or whiskey, if desired).

In addition to these foods it is advisable to begin the diet with an addition of a small amount of carbohydrate, 15 to 20 grammes. The reason for this is that certain patients develop quite rapidly a definite acidosis when suddenly deprived of all carbohydrate. A slice of bread, three by four inches, and one-half inch thick, will approximate 10 grammes of starch. Twenty grammes of starch a day, two slices of bread, is adequate protection from serious acidosis. A positive Gerhardt's test may be ignored when the ammonia nitrogen is but 1 or 1.5 grammes per day. On this diet many diabetics cease to excrete glucose within ten days. After the urine has been kept free of

¹ Part of bread allowance may be taken at breakfast.

² The remainder of the day's allowance of bread should be used at this meal.

sugar for several days the diet is to be enlarged by the method to be mentioned later.

On the above diet other cases of diabetes continue to excrete small amounts of sugar after ten days (class 2). As this sugar, even though trivial in amount, indicates that hyperglucæmia still persists, and further dietetic change is required, it becomes necessary to interpolate days when the total quantity of food is restricted. Naunyn used a starvation day, but the same end may be obtained with less discomfort to the patient by a scheme such as the following:

Morning: Omelette of four egg yolks with tomatoes and parsley; 1 large cup of coffee with tablespoonful of cream.

Noon: One small piece of fish, 50 grammes; spinach with butter or oil *ad libitum*; one glass of claret or whiskey.

Four o'clock: Cup of bouillon.

Evening: Asparagus or cabbage served hot with butter; yolks of two eggs soft boiled; tea or coffee (no sugar or cream).

This vegetable day may be used once a week or at most every fourth day. The urine of this day must be watched for signs of acidosis. When the total sugar excretion has been reduced to five or ten grammes a day and will not reduce further, as occasionally happens, this vegetable day is a potent means of clearing up conditions.

Up to this point no mention has been made of the dietary indications in acidosis. When this is a pronounced condition it is necessary to use alkalies at all times and to meet the condition in so far as possible by diet. The oatmeal diet gives the best results, and consists of 64 ounces of oatmeal gruel,³ black coffee in small amounts if desired and water *ad libitum*. This diet is given solely to combat acidosis, but it not infrequently happens that sugar excretion diminishes or vanishes with its use. An oatmeal day may be used once or even twice a week in severe cases, and when the sugar excretion is excessive or obstinate a vegetable day followed by an oatmeal day reduces both sugar and ketone excretion.

³ To prepare oatmeal gruel cook in a double boiler, for at least 6 hours, ten ounces of oatmeal in two quarts of water, slightly salted. While still hot strain through a sieve and add three ounces of butter and stir well.

When the urine becomes free of sugar it is wise to delay at least five days before permitting an increase in the starch ingest. The increase must be made sooner or later if it is possible to do so without inducing a return of glucosuria. In order to facilitate this gradual building up of a diet the unit table is employed. The starch content is expressed in units, instead of grammes, as patients grasp this more quickly; ten grammes of starch is one unit. The values are approximate only. Table II supplements Table I; as all foods in the latter may be used *ad libitum*.

TABLE II.

The food in this list to be taken only in the amounts ordered.

Soups:

Bean	average portion equals one unit.
Clam chowder	average portion equals one unit.
Cream of corn	average portion equals one unit.
Pea purée	average portion equals one unit.
Potato	average portion equals one unit.
Tomato	average portion equals one unit.

Vegetables:

Beans, baked,	2 tablespoonfuls.....	equal	2 units.
Beans, butter,	2 tablespoonfuls.....	equal	1 unit.
Beans, lima,	2 tablespoonfuls.....	equal	2 units.
Beans, kidney,	2 tablespoonfuls.....	equal	2 units.
Beets,	2 tablespoonfuls.....	equal	1 unit.
Corn, green,	1 ear.....	equals	2 units.
Onions,	2 onions.....	equal	1 unit.
Corn, canned,	2 tablespoonfuls.....	equal	2 units.
Green peas,	2 tablespoonfuls.....	equal	1 unit.
Potato, baked,	1 medium sized.....	equals	3 units.
Potato, boiled,	1 medium sized.....	equals	3 units.
Potato, mashed,	2 tablespoonfuls.....	equal	2 units.

Fruit:

Apple,	1 medium sized.....	equals	2 units.
Blackberries,	2 tablespoonfuls.....	equal	1 unit.
Currants,	3 tablespoonfuls.....	equal	1 unit.
Huckleberries,	2 tablespoonfuls.....	equal	1 unit.
Orange,	1 medium sized.....	equals	2 units.
Peach,	1 medium sized.....	equals	1 unit.
Pear,	1 medium sized.....	equals	2 units.
Plum,	2 medium sized.....	equal	1 unit.
Raspberries,	3 tablespoonfuls.....	equal	1 unit.
Strawberries,	4 tablespoonfuls.....	equal	1 unit.

Cereals:

Bread, slice 3 x 4 x $\frac{1}{2}$ inch.....	equals 1 unit.
Hominy, boiled, 1 tablespoonful	equals 1 unit.
H-O, boiled, 2 tablespoonfuls.....	equal 1 unit.
Macaroni, boiled, 2 tablespoonfuls.....	equal 2 units.
Macaroni, baked	
with cheese, 2 tablespoonfuls.....	equal 2 units.
Oatmeal, boiled, 2 tablespoonfuls.....	equal 1 unit.
Rice, boiled, 1 tablespoonful	equals 2 units.
Shredded wheat biscuit, 1	equals 2 units.
Spaghetti, baked	
with tomato, 2 tablespoonfuls	equal 2 units.

One may begin by advising for a diabetic whose urine has been free of glucose for one week, that he use three units a day (30 grammes of starch). If there be no return of sugar one unit may be added every week until the patient is using 70 to 80 grammes of starch per day. Further additions should be less frequent and it is a safe rule to permit no more than ten units (100 grammes starch) during the first six months of treatment, even though the urine may be constantly devoid of sugar.

There are undoubtedly cases of diabetes in which the foregoing dietetic treatment will not render the urine sugar free. These require such a very careful balancing between ingestion of starch and excretion of sugar that it can be done only by weighing each, and the consideration of this would lead us away from what we wish to emphasize, that diabetic patients should receive dietetic treatment while under the surgeon's care and that this will favorably influence the surgical condition, and, in the majority of cases, will save the patients from the grievous mutilation of amputation through the thigh. Although arteriosclerosis is usually present, we believe that it is the diabetes which is the unfavorable condition which impairs the cellular nutrition and so lowers cell resistance, rather than the arteriosclerosis, and so these cases demand and must receive a different treatment than those suffering from so-called senile gangrene dependent on endarteritis obliterans.

We wish to express our thanks to Drs. Blake and Peck for the privilege of reporting their cases.

COMPLETE AVULSION OF THE SCALP

WITH A REPORT OF A CASE.*

BY FREDERICK FLAHERTY, M.D.,

OF SYRACUSE, N. Y.,

Professor of Clinical Surgery in Syracuse University.

COMPLETE scalping of an individual is a sufficiently rare accident to make the report of a case of interest. A few scattering cases have been reported in literature until 1910, when Davis, of Baltimore, in an original memoir reported two unpublished cases, one in the service of Dr. Bloodgood and the other his own, together with a rather exhaustive review of the literature upon this subject, reporting in all 91 cases of complete scalping, 80 of which were due to machinery. In 53 cases due to machinery the line of tearing included one or both eyebrows, in 19 cases it passed above the eyebrow, while in 8 cases it was not reported. Another interesting fact was that 79 of the 80 cases were females and one male, and he was a Chinaman and caught his cue. There was periosteal defect in 29 of the cases. Fifty-seven cases were grafted with complete healing in 33 cases. The mortality was 10 per cent. Of the other 11 cases of complete scalping which Davis reported, 7 were done by Indians and 4 occurred from other causes.

The case which I now report is that of a woman, who on September 9, 1912, while working in a private laundry, caught her hair in a revolving shaft. The scalp was completely torn from the skull from a line below each eyebrow in front, including the upper half of the right ear and the upper portion of the left ear, back to the hair border posteriorly. This made a denuded area 13 inches by 16 inches. There was an area of denuded bone over the left side of the frontal and left parietal bone, which measured about 7 inches in length and 2 inches in width.

I saw her soon after she entered St. Joseph's Hospital. She

* Read before the Syracuse Academy of Medicine, October 7, 1913.

FIG. 1.



September 12, 1911. Three days after the accident.

FIG. 2.



July, 1913. Ten months after the accident.

FIG. 3.



July, 1913. Ten months after the accident.

was perfectly conscious, and not suffering much from shock. There was very little bleeding. The interne had tied one small artery on the top of the back of her head. There was avulsion of the right thumb and laceration of the ring finger. To me it was the most frightful appearing trauma I had ever seen in my experience at the hospital.

She stated that she was fixing the washing machine, which was in motion, while making an adjustment she suddenly raised her head. Her hair was immediately caught on a rapidly revolving shaft, winding the hair tightly about the shafting, completely removing the scalp. She put her right hand up to her head in an attempt to free her hair, the hand was caught, the thumb and ring finger were badly lacerated. The patient was alone in the laundry at the time of the accident. As soon as her hair caught she called loudly for help. There was no one at hand so that she was obliged to extricate herself from the machine and walked a distance of twelve feet, where unassisted she stopped the motor. Her hair and scalp were found tightly wound around the shafting. After stopping the motor she sat down in a chair and wrapped a towel around her head. She remained perfectly conscious and was able to give an accurate account of how the accident occurred.

We did not make any effort to cleanse the surface other than to apply hot boric acid compresses. Four days later under ether anæsthesia we covered as much of the right side of the head as was feasible, using Thiersch grafts from the right thigh. Practically every graft we applied at this time grew and became good, firm skin. One week later we covered the left side of the head, using the same method and taking skin from the left thigh. At the second operation we bored a series of rings, using a trephine, through the outer plate of the skull in the area of bare bone, for the purpose of allowing the granulations to grow up and afford a granulating surface on which later we could graft.

On October 28, five weeks later, we found the denuded area covered with healthy granulations. Again with ether anæsthesia we covered this area with Thiersch grafts. This idea occurred to me from a note in an article by Mellish in the *ANNALS OF SURGERY* in 1904 where he quoted a man by the name of Vance, who in 1777 advocated the boring of small holes in the outer plates of denuded bone following scalping by Indians, for the purpose of favoring the healing of the surface by granulation. This proved

to be a very valuable means of covering the bare bone. However, before this area entirely healed, a number of small spiculæ of bone were thrown off, which were the centres of the rings made by the trephine.

In another case I should remove these little plates before placing the grafts. The upper left eyelid at the time of the third operation was retracted and necessitated a graft, to overcome a marked retraction of the eyelid.

Our method of Thiersch grafting is a modification of the regular Thiersch graft, which we have now used for several years, and we find it much more efficient. The grafts are removed in the regular manner, using a sharp razor on the stretched skin. They are then applied to the raw surface, allowing the serum to hold them in place, no solution or moisture being applied. After having covered the desired surface with grafts, it is immediately covered with either bismuth powder or gauze covered with sterilized vaseline, or simple bismuth ointment. This dressing is allowed to remain in place for 4 days, when upon removal, the grafts are found growing much more satisfactorily than when the moist method is used.

Several principles of skin grafting were clearly demonstrated in this case, which I would like to emphasize. First, only autodermic grafts should ever be used to obtain the best results. One so often reads of the self-sacrificing friend or relative, who is placed under an anæsthetic in order to furnish skin so that it can be placed on the injured person. Only about one year ago the newspaper reported the death of one such person, who died while giving his skin to another.

Skin taken from another individual does not grow nearly as satisfactorily as when taken from the individual himself, much less does the skin from animals, etc. In practically all the cases recorded there was either complete or partial failure, and even if the grafts grew, they usually sloughed.

In the case I am now presenting I found it possible to get very good grafts from the same area on the thigh, where I had obtained grafts only 6 weeks previously. All that seemed necessary was not to make the grafts too thick.

In all of the cases reported, great difficulty has been found in healing small areas of ulceration, which later form as the result of excoriation due either to the wig or lying on the head. Our method of treating these small ulcerations, which we found to be very simple and yet very efficient, was to plant one or two small Reverdin grafts in the ulcerated area. This has always produced very quick and satisfactory results.

In a case of complete avulsion reported by Abbe, it was estimated that over 12,000 grafts were placed before a satisfactory result was obtained. In the two cases reported by Davis, the one in Dr. Bloodgood's clinic was admitted August 24, 1906, was discharged March 8, 1907, but three years later there still existed five small ulcers, the largest being as large as a ten-cent piece. The case had been treated by Thiersch grafts, after first allowing granulation to form. The first graft being taken from another person with total failure, later autodermic grafts were successful.

The second case was injured July 29, 1907, six weeks later a Thiersch grafting was attempted with unsatisfactory results. The following year Thiersch grafts from a lamb were unsuccessfully tried. In May, 1909, nearly two years after the accident Dr. Davis, after thorough preparation and treatment of the granulating surface, grafted whole thickness grafts successfully in about eight different operations. He believed that he obtained much better results than occurred in the cases in which the Thiersch method had been employed.

The question naturally arises in these cases whether it is not possible to replace the scalp if the case is seen immediately. Davis found in his series, that 21 attempts had been made to replace the scalp in complete avulsion, with total failure in every case with a possible exception of one, in which the replaced scalp died, but turned into a parchment-like covering, which remained adherent to the cranium, and under which healing took place without complications. Thus it can readily be seen that it acted only as a form of a dressing, and not in any way as a graft.

Robinson, in *Surgery, Gynecology and Obstetrics*, volume

ii, reports a case of complete avulsion in which he used Thiersch, and Reverdin, and later Wolfe-Krause grafts at different times, starting the grafting immediately after the injury, and not waiting for granulation. He, likewise, found the grafts taken from the patient's relatives at the end of 3 or 4 weeks, dissolved or digested notwithstanding that they grew nicely for 2 or 3 weeks and finally disappeared. He agreed with Davis that the whole thickness grafts when autodermic seemed to give the best results.

Contrary to the opinion of many observers, I have never found that simple ointments macerated or tended to destroy the grafts when autodermic, but on the contrary simple sterilized vaseline with or without bismuth has given me most excellent results as a protective covering in many cases.

My case left the hospital in 67 days, with the head completely covered with good firm skin, but like all of the other cases reported there was a tendency for small ulcerations to form for a short period. In the case reported by Binings, of New York, in the *Philadelphia Medical Journal*, June 7, 1902, he had a similar experience in using grafts other than from the individual herself. It would, therefore, seem that in extensive skin grafting certain principles should be observed. First, that it is not necessary for granulation to form in order to obtain the best results, again, that it is useless to attempt to replace large areas of skin completely separated from the body, and that only autodermic grafts should be used, and that it is possible to secure good grafts from the same area if necessary in 5 or 6 week intervals.

INTRATHORACIC GOITRE.

REPORT OF TWO CASES WITH MARKED DISPLACEMENT OF TRACHEA.

BY O. F. LAMSON, M.D.,

OF SEATTLE, WASH.

THESE two cases of intrathoracic goitre which were recently operated on by the writer, seem to be of sufficient importance to warrant a brief report of their clinical progress and ultimate relief through surgery.

The symptoms of these two cases were necessarily chiefly respiratory because of pressure on the trachea, bronchi and lungs, and consisted of coughing, wheezing and dyspnoea which, at times, almost amounted to suffocation.

In the diagnosis, aneurism and malignant growths were considered in both cases, but in the absence of a bruit, thrill and pulsation over the area of dulness, the former was ruled out and malignancy was finally ruled out on account of the chronicity of the symptoms and lack of emaciation.

The history of the onset of the symptoms, together with a circumscribed area of dulness, and the X-ray plates which revealed a tumor beneath the sternum extending up to the lower pole of the thyroid gland, with displacement of trachea to the right, led to the belief that the intrathoracic growths which undoubtedly were present, had their origin in the thyroid gland, and the findings in the operating room confirmed this conclusion.

At the time of their appearance in the office, there was a marked similarity in the symptoms the patients complained of, and examinations revealed similar findings; however, there was a difference in the manner of their development.

In Case I there was a cyst which developed at the lower pole of the gland, as it grew, extended downward into the mediastinum, and at the same time there was some enlargement of the thyroid gland in the cervical region, which about one and a

half years ago disappeared, as the patient stated (probably during a fit of coughing it was drawn beneath the clavicle and was retained in the thoracic cavity); after that, beginning rather acutely, there was a marked increase in the severity of her symptoms which were gradually growing worse.

In Case II there was never any sign of any visible goitre, the growth having developed at the lower pole of the gland and extended downward into the mediastinum, during the entire course of its growth, producing such marked narrowing of the trachea as to almost strangulate the patient.

This patient had been treated for asthma off and on for ten years, both by internal medication and at various health resorts, and recently underwent operations on the nasal passages with the idea of relieving his symptoms.

When both of these patients were seen at the office breathing was extremely difficult and both gave histories of spells in which they were threatened with suffocation.

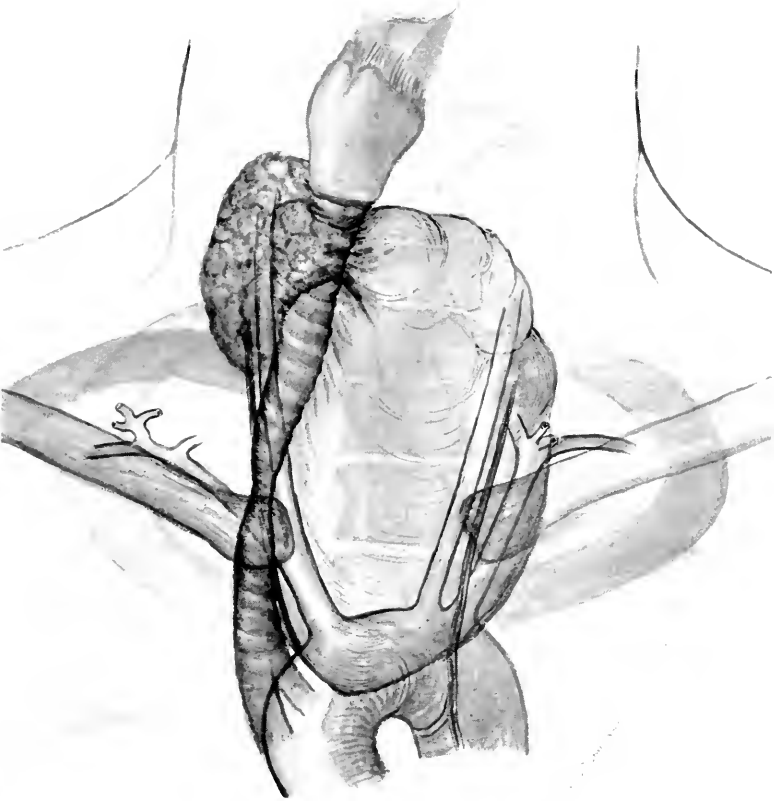
CASE I.—T. V. M., female, age forty-five. Married.

Personal History.—Always been well except for present trouble. Has borne two children, ages sixteen and fourteen respectively.

Present History.—Patient seeks medical aid because of cough and shortness of breath, which has been marked for the past one and a half years and gradually getting worse. Patient says that for several years past she has had some enlargement rather low down, in region of left lobe of thyroid gland; about one and a half years ago the mass disappeared and shortness of breath became marked, from which time it has gradually grown worse; past four weeks dyspnoea has been very distressing and has had six or eight spells in which she almost strangulated. Her voice has been husky for past six months.

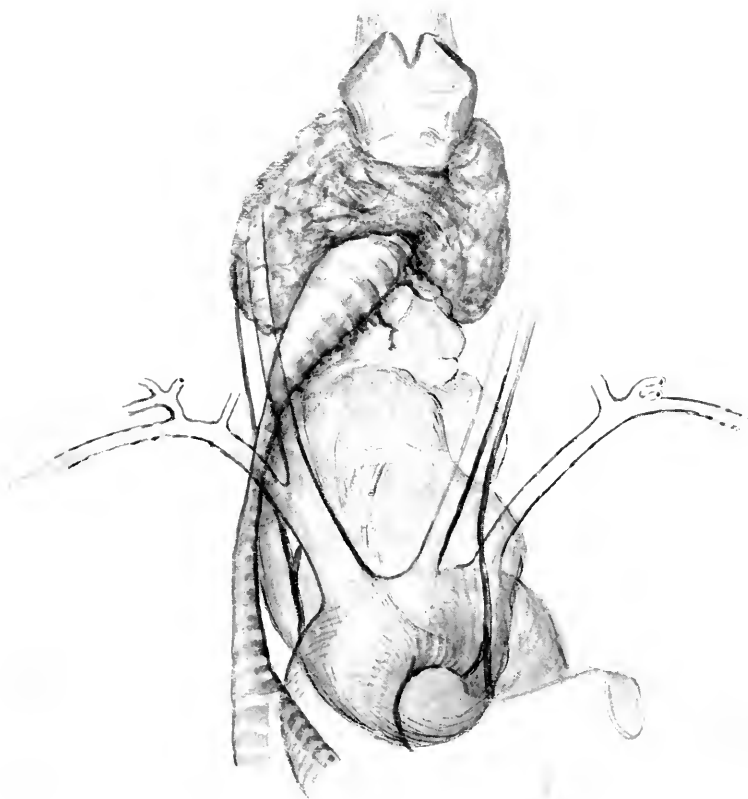
Examination.—No visible tumor on ordinary respiration but on having patient cough there was noticed a rather marked bulging in suprasternal and supraclavicular region. Larynx and upper trachea could be noticed pushed to the right. Percussion revealed an area of dulness extending to right of midline downward to third rib and outward to left of midline about three and one-half inches and upward to the lower pole of left lobe of thyroid gland.

FIG. 1.



Drawing constructed after X-ray plate.

FIG 2



Drawing constructed after X-ray plate.

X-ray revealed shadow in region corresponding to the dulness on percussion, and displacement of trachea to right (see Fig. 1, constructed from skiagraph). Examination of throat revealed paralysis of left vocal cords.

Operation (June 3, 1913).—Done under local anæsthetic (novocaine) because of marked dyspnoea and fearing that patient would not take general anæsthetic well. Large colloid cystic goitre (intrathoracic) removed. Patient's breathing improved immediately and she has made an uneventful recovery.

Skiagraph taken two months after operation shows trachea in normal position.

CASE II.—F. N. S., male, age thirty-nine.

Family History.—Mother and her two sisters were afflicted with goitres.

Personal History.—Says he was never seriously ill except for so-called asthmatic spells which have bothered him off and on for ten years.

Present History.—Patient says he has been troubled with asthmatic attacks for about ten years, coming on intermittently and usually preceded by a slight cold, and worse in winter. For past four years troubled with distressed breathing, wheezing, cough; been gradually getting worse and has noticed some enlargement in region of right lobe of thyroid gland (caused by displacement of trachea to right and not by any enlargement of right lobe of gland) for past two years. January, 1913, had a sensation as though he was being strangulated, which persisted for about four weeks, coming on following a slight cold, also a similar spell in June, 1913.

Examination.—Patient's facial expression one of extreme anxiety; breathing is of stertorous type, face flushed (at times slightly cyanotic). Percussion reveals dulness extending from right of midsternal line to left about three and a half inches and downward to third rib and upward to lower pole of right thyroid gland. X-ray revealed shadow in this region, and displacement of trachea to right as in Case I (see Fig. 2, constructed from skiagraph).

Operation (July 3, 1913).—Local anæsthetic (novocaine) for same reason as in Case I. Removal of cyst resulted in marked improvement in patient's breathing before he left the operating table and his recovery since then has been complete.

Skiagraph taken twenty-five days after operation shows trachea in normal position.

The writer wishes to express his appreciation to Dr. Wm. Teepell for the most excellent X-ray plates from which the diagrams were constructed.

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AN ŒSOPHAGOSCOPE WITH DIRECT OUTSIDE ILLUMINATION.

BY NATHAN W. GREEN, M.D.,

OF NEW YORK.

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My object in bringing out this form of œsophagoscope is to have, first, a strong projected illumination with a minimum of light reflexes; second, to have the electrical connections entirely outside the tube; third, to have the electrical connection as simple as possible; and fourth, to have the whole instrument, except the ocular and electric light, sterilizable by boiling. It has also been my object to have a universal light carrier adaptable to any length and size of œsophagoscope (Fig. 1).

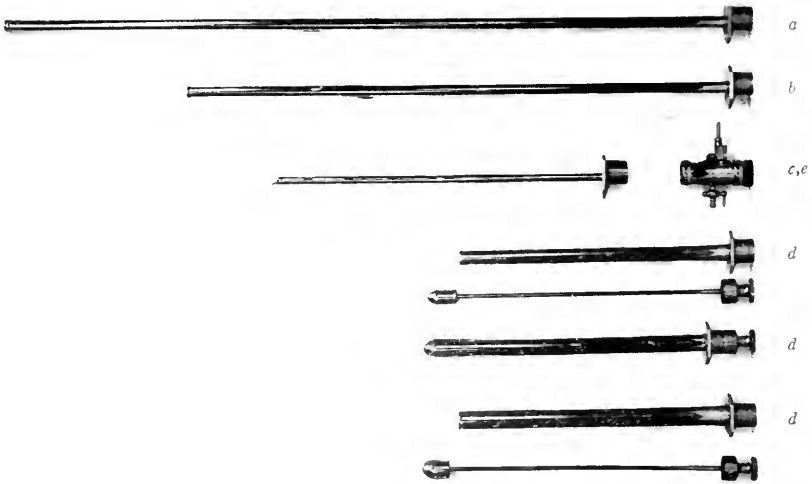
Description.—In many details this instrument differs from the others now in use. Its principle may be understood by referring to Fig. 2.

The tube part of the œsophagoscope (Fig. 3) is 48 cm. long and 10 mm. in diameter. At the distal end is the usual ring placed to guard against wounding the tissues during introduction (it is entered in the œsophagus over a flexible bougie). At the proximal end of the tube is an enlargement 20 mm. in diameter tapered on the outside to fit the light carrier, and conically bored on the inside eccentrically to the axis. This whole proximal end piece is attached to the tube eccentrically. The light carrier is shown in Figs. 4 and 5. It consists of a cylinder 52 mm. in length, with an internal diameter of 20 to 22 mm., to fit over the end of the tube. Let into one side of it is a half cylindrical chamber 25 mm. in length and 8 mm. in diameter. In the distal end of this chamber is a planoconvex lens. On the opposite side of the light carrier is a small pet-cock permitting the introduction of air under pressure when needed. At the proximal end of the light carrier is fitted an air-tight eye piece containing either a plain glass or a lens, as may be required. This is removable when it is desired to pass instruments down the tube. The light is supplied by a high efficiency electric bulb, which is set into the hemicylindrical chamber from the outside. This light can be moved backward or forward by loosening the thumb-screw (*A*), thereby focussing the light with a certain degree of accuracy at the end of the long tube. The divergent rays are cut down by a small diaphragm which encircles the 8 mm. lens (*B*). The object in this way of dealing with the light problem has been to utilize one-half of a strong electric light, and to throw the rays by means of the planoconvex lens down the tube as parallel rays. At the same time, the

polished interior of the tube aids in the lighting effect. The amount of the encroachment of the hemicylindrical chamber which holds the light (*C*) upon the lumen of the tube is regulated by turning the light carrier upon the eccentrically placed proximal end of the tube. It is possible in this way to get ample illumination and, at the same time, make use of instrumentation through the tube without any interference from the hemicylindrical chamber of the light carrier. When the eye is applied to the eye piece, the full field at the end of the tube can be seen without interference to vision.

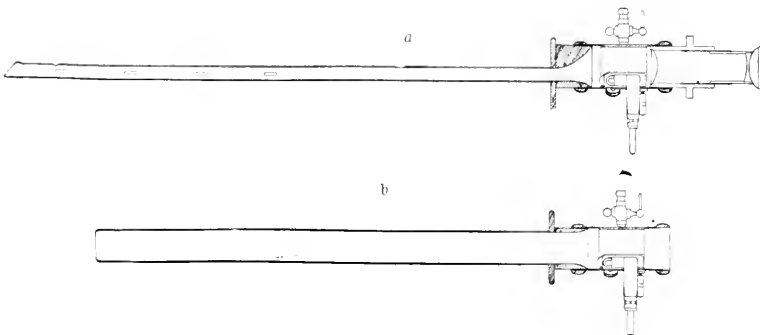
I have been fortunate in having the advice and assistance of Mr. R. Wappler in working out the mechanical details of this principle. The instrument has been in use for a year and has given satisfaction.

FIG. 1.



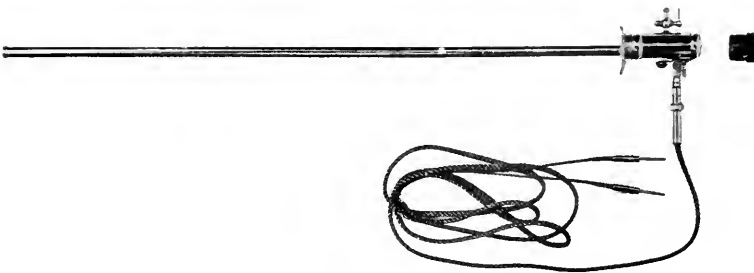
Showing *a*, gastroscope; *b*, oesophagoscope; *c*, bronchoscope; *d*, proctoscope tubes; *e*, universal light carrier.

FIG. 2.



Showing *a*, section of bronchoscope with lens system; *b*, section of proctoscope. It is to be observed that the light carrier fits either tube, although they differ greatly in calibre.

FIG. 3.



Showing oesophagoscope assembled.

FIG. 4.

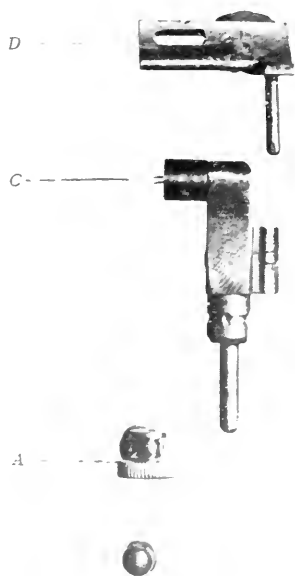
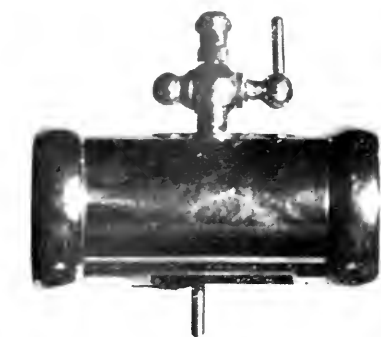
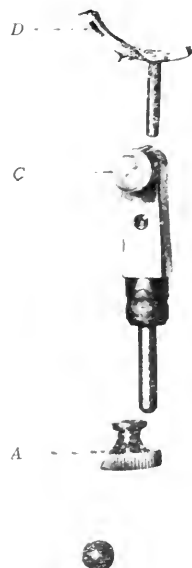
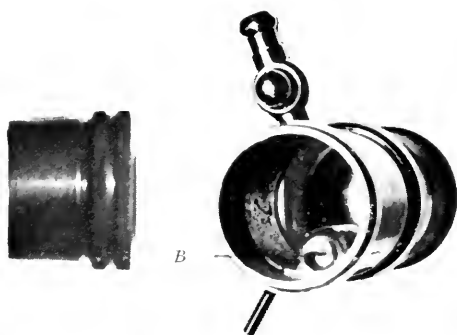


FIG. 5.



FIGS. 4 and 5.—Showing component parts of light carrier. Thumbscrew A, for focussing slide D, to which is attached electric lamp C. The focussing is accomplished by moving the lamp toward or away from the small planoconvex lens B.

THE RELATION OF POSTERIOR SUBLUXATION OF THE SHOULDER-JOINT TO OBSTETRICAL PALSY OF THE UPPER EXTREMITY.*

BY T. TURNER THOMAS, M.D.,

OF PHILADELPHIA.

OBSTETRICAL palsy involving the upper extremity only is ascribed almost universally to injury of the brachial plexus affecting, especially, its fifth and sixth cervical roots. It is almost as generally agreed that the much more frequent brachial palsies from injuries of the shoulder region in adults, are due to a similar lesion of the brachial plexus. In a study of the latter, published in the *ANNALS OF SURGERY*, January, 1911, I concluded that most of them resulted from sprains and dislocations of the shoulder-joint, the essential lesion in both being a laceration of the axillary portion of the joint capsule and the palsy resulting from the inclusion of the branches of the brachial plexus in the adjacent axillary inflammation. Because the obstetrical palsies are, evidently, of the same nature as these adult palsies, I suggested that in many cases they also are due, primarily, to injuries of the shoulder-joint. In June, 1912, in Nos. 23 and 26 of the *Münchener Medizinische Wochenschrift*, F. Lange published two papers, in which he put forth, essentially the same theory. In the first paper he discussed under the title of "Distortion of the Shoulder" which he ascribed to laceration of the anterior portion of the shoulder capsule, the same group of cases, evidently, which I had described as "Stiff and Painful Shoulders,"¹ and had ascribed to laceration of the antero-inferior portion of the capsule. According to my experience and judgment, all sprains and dislocations of the shoulder-joint are associated early with some brachial palsy, as well as with stiffness and pain at

* Read before the Philadelphia Academy of Surgery, October 6, 1913.

¹ American Journal of the Medical Sciences, April, 1911.

the shoulder. In most cases the palsy is mild and transitory, in some it is very severe, but even in these it is probably rarely permanent. Lange did not refer to the palsy in his adult cases but in his second paper, devoted to obstetrical palsies of the upper extremity, he ascribed most of these palsies to laceration of the capsule of the shoulder-joint. Of his 17 palsied arms (in 15 patients), he regarded 13 as undoubtedly pseudopalsies, due to laceration of the capsule, and in 15 of the 17, he found the same position of the arm as in his "distortions" of the shoulder in adults. According to Lange, Küstner believes that the obstetrical palsies are due to epiphyseal separations of the upper end of the humerus with rotatory deformity, while Finck believes that they are due to preglenoid dislocations of the shoulder.

While the brachial plexus theory is generally accepted, particularly for the obstetrical palsies, there has been much discussion as to how the plexus is injured at birth and a variety of mechanisms have been suggested. The greatest difficulty has been found in accounting for the localization of the injury to the junction of the fifth and sixth cervical roots of the plexus. When a more or less general brachial paralysis follows soon after an injury to the shoulder region, the obvious cause is an injury to the brachial plexus. The relation of an injury of the shoulder-joint to such a paralysis, is much less obvious. It has seemed to me that the localization of the injury to the junction of the fifth and sixth cervical roots rested on an uncertain basis until supported by operations on the plexus. Certain it is that in the great majority of cases, electrical examinations are not made to determine what muscles are paralyzed. The diagnosis is, evidently, made upon the history of a paralyzed upper extremity, first observed immediately after birth, and upon the characteristic internal rotation of the whole limb. Electrical examinations soon after birth are exceedingly unsatisfactory and unreliable and are rarely made. Fairbank,² who recently reported probably the largest experi-

² *Lancet*, Lond., May 3, 1913, p. 1217.

ence with obstetrical palsy, says that electrical examinations are not advisable before the end of the second month, the use of an anæsthetic being essential, but by this time the case will probably show definite signs of recovery, so as to render electrical examination unnecessary. Sherren does not test the electrical reactions until the age of three months.³ The fact that, in most cases, there is practically no disturbance of sensation in the affected limb, although the roots of the brachial plexus are all mixed nerves, has not been satisfactorily explained.

The most substantial support of a plexus origin has been furnished, in about the last decade, by a few surgeons who have exposed the plexus in a small number of cases. In most of them the plexus was found enveloped in adhesions, in some the nerves were thickened and in a few one or more roots were found divided and the torn ends retracted. Only the last group, in my opinion, furnish substantial evidence in favor of the plexus theory, and even these need further confirmation. Without operation, it appears that the paralysis recovers spontaneously, in most cases, after a time, and time is not particularly important to these young patients. It has seemed to me that before the plexus should be exposed, definite areas of impaired sensation should be located. If these operations become common, there will probably be fewer complete recoveries of the paralyses than there are now. The operation was advised in one of my cases with posterior subluxation and was refused. That patient has been improving ever since and after about three years has recovered much power in the affected limb. In my opinion, the average surgeon without the facilities for careful study by dissection of the anatomy of this region, should not attempt to lay bare the delicate cords of the brachial plexus in the young child. The plexus is deeply situated in a confined region, surrounded by very important vessels and nerves, the cords of the plexus lying close together interweaving with each other and embedded in a mass of adhe-

³ *Injuries of Nerves and Their Treatment*, 1908, p. 209.

sions. Even in the hands of the able surgeons who have reported the results of their operations the proportion of cases showing divided nerve roots has been very small. Fairbank operated on five cases and found rupture of the nerves in only one. This involved the fifth and sixth cervical roots which were torn across at their junction. Even in this case electrical stimulation before operation and of the nerves at operation, "made it certain that there must have been some fibrils passing on from the fifth cervical root or the fifth and sixth cervical to the bulbous common trunk (distal end of rupture), though dissection suggested complete division." Lange exposed the branches of the brachial plexus in the axilla in a case of obstetrical palsy, and found the cause of the paralysis to be the embedding of the nerves in thick connective tissue, for an extent of 4 cm., and found also a diminution and deformation of the head of the humerus. This is the only case of obstetrical palsy, of which I have knowledge, in which the nerves have been exposed in the axilla where they are adjacent to the shoulder-joint. I would suggest that the exudate and adhesions about the plexus, found so uniformly in operations above the clavicle, are the result of extension upward of the blood and synovial fluid from an injured shoulder-joint, which in the new-born is only a few inches below the plexus. The almost recumbent position of the infant would favor this upward extension. Boyer⁴ recently reported a very interesting case of obstetrical palsy in a woman who died in an insane asylum, and upon whom an autopsy showed clear evidence of tearing of the cervical roots, on the right side, from the spinal cord, the rupture affecting particularly the seventh cervical. The brachial plexus of the left side appeared normal in size and origin. The roots of the fifth, sixth, seventh and eighth cervical on the right side were much smaller than natural and were reduced to fibrous cords, which were impossible of good dissection owing to the abundance of tough fibrous tissue. Boyer calls attention to the fact that the usual excision of a

⁴ Proc. Roy. Soc. Med. (Neurological Section), 1912, p. 31.

part of a nerve trunk, as Kennedy suggests, would not have done good in this case but would have done harm. Mills⁵ reported similar findings upon exposure of the cervical portion of the spinal cord by Frazier, in a case of severe brachial paralysis in an adult following an injury to the shoulder region. These cases show conclusively that rupture of the cervical roots of the brachial plexus do occur in some cases, but they do not favor the prevailing view that the rupture usually takes place in the neck at the junction of the fifth and sixth cervical.

My conception of the obstetrical palsies resulted from a previous study of the adult brachial palsies, which in turn had its origin in a study of the anterior dislocation of the shoulder, including its mechanism, lesions and sequelæ. In my judgment, the dislocation is the key to the solution of the problem involved in most of the adult cases. I believe now that the posterior subluxations of the shoulder associated with obstetrical palsies, will prove to be the key to the solution of the problem in most of these cases. Since the adult palsies have led me to study the birth palsies, I wish to state very briefly, my position in connection with the adult cases. The most damaging movement at the shoulder is hyperabduction. Forced external rotation has a similar effect, but is probably of secondary importance to hyperabduction. The capsule maintains the continuity of the skeleton at the joint and takes up, here, the forces applied to the skeleton, so that a break in the skeleton at the joint involves, primarily, the capsule. The end result of hyperabduction at the shoulder-joint is an anterior dislocation, a sprain usually being merely an aborted dislocation. If the joint is immobilized after a sprain or the reduction of a dislocation, a more or less severe palsy of the whole limb will develop because of the involvement of the branches of the brachial plexus in the adjacent axillary inflammation. The palsy and atrophy will be most marked about the shoulder, but occasionally the muscles of the hand and forearm will be most affected, as in Case II. In many cases the palsy improves so

⁵ Pennsylvania Medical Journal, 1910-1911, p. 850.

rapidly that it is overlooked or ignored. Sometimes it is so severe and persistent that it cannot be ignored and then is usually ascribed to an injury of the brachial plexus. The best evidence that it is not due to an injury of the plexus is the fact that with the restoration of the normal motion to the shoulder-joint the palsy disappears rapidly. If the dislocation remains unreduced, the palsy will improve slowly, but will never entirely disappear because of the interference with the function of the joint, and perhaps also because of pressure of the dislocated head on the adjacent nerves. I have selected the following adult cases for illustration of different types of brachial paralysis of shoulder-joint origin:

CASE I.—A woman, forty years of age, teacher of drawing. On May 13, 1913, on stepping from a row-boat which began to move away from the shore of a small lake, she grasped a post on the shore with her right hand, keeping both feet in the boat. The boat moved from the shore and dragged her feet until her body was almost horizontal and her right arm in full abduction, in which position she pulled the boat to shore again. She had some pain in the shoulder immediately but it was not particularly noticeable until about an hour later, and on the following day it was worse. On the third day Dr. W. Drummond located severe tenderness over the greater tuberosity of the humerus. On the same evening he manipulated the shoulder to exclude the possibility of a dislocation, and during the manipulations observed a sensation as though the humeral head jumped out of the socket and back again, and felt distinct crepitus. The skiagraph taken on the fourth day seemed to show a fracture of the greater tuberosity, although this was not very clear. The arm was then bound in the Velpeau position, for 14 days, and on removing the bandage, the right arm hung helpless at her side and she could scarcely move a finger. This frightened her very much, because she had recently come from England to take a position as teacher of free-hand drawing, which required perfect movement of the arm. She was compelled to cancel her engagement and go back home. An insurance company, after the examination by its physician, quickly settled with the patient on a basis of five months' incapacity for work, indicating that the insurance physician regarded the

paralysis in a serious light. In the three days which intervened between the removal of the bandages and her departure from the country, there was a considerable improvement in motion and power, especially in the hand and forearm. I had to be content with giving her instruction as to the exercises which she should follow. I heard first from her under date of August 12. She still suffered from pains in the shoulder and arm, but the power and movement of the limb were "wonderfully better." She was still unable to put her hand back far enough to fasten a dress skirt, could not put the hand to the back of her head without pain, and could not raise the arm straight above her head. These, however, are among the last restrictions of movement to disappear. She had fitted up a black-board recently to try her drawing ability and was "quite greatly surprised as to the power of the right hand." All she needs is to apply force enough to stretch the still contracted tissues sufficiently to give her normal motion.

If the paralysis in this case were due to actual rupture of nerve fibres of the brachial plexus, it should have come on immediately after the injury. That the shoulder-joint was the chief seat of injury was evident from the pain and limitation of movement there, and the joint injury with the associated involvement of the branches of the plexus in the adjacent axillary inflammation, will explain every phase of this case. This type is very common, the palsy affecting most and being last to disappear from the muscles of the shoulder region.

CASE II.—Man, thirty-nine years of age, mechanic. On about May 18, 1911, received a heavy blow on his left shoulder from a falling board, while at his work. Suffered severe pain in the shoulder at the time, and during the rest of the day had a peculiar numb sensation in his left hand but continued at his work. On the following day he had no power in it and the power in his forearm and arm were much below normal. Admitted to the nervous ward of the Philadelphia Hospital, May 20, 1911, in the service of Dr. J. Hendrie Lloyd. The following is a very brief synopsis of Dr. Lloyd's examination of the case: Restricted power in arm and forearm and total paralysis of hand. Has no use of any of his fingers. Complete wrist drop. Ribbon shaped area of anæsthesia, about two inches wide, along ulnar side of forearm.

Scapulohumeral ankylosis. Cannot abduct arm to a right angle. Diagnosis: Musculospiral and ulnar paralysis with total paralysis of hand. After seeing the case with Dr. Lloyd, June 6-19, 1911, he asked me to treat it. On the following day I forced the arm into full abduction and external rotation, with the patient under ether, and fixed it in external rotation and almost full abduction on an obtuse angle splint, keeping the patient in bed. Although I cannot explain the rapidity with which the improvement developed, it was striking. On the following day, June 21, the little and ring fingers could be flexed slightly. June 22, could flex all the fingers slightly. With palm turned downward, could extend hand at wrist slightly. The ribbon-shaped ulnar area of anæsthesia had disappeared to such an extent that he could feel pain sense readily, although he still had numb sensations in this area. June 23, could flex and extend thumb fairly well and could flex fingers about one-fourth way toward making a fist. Motion at wrist also increasing. June 27, could grasp objects weakly with affected hand. Still had slight numb sensations along ulnar border of forearm. July 19, considerable atrophy of left arm and forearm. Sensation good in all parts of limb. Movement in left thumb almost as free as in right thumb, but power much less, and last phalanx could not be flexed as far as in right thumb. Could close fingers about three-fourths as well as on right side. Index finger did not flex quite as well as others. Could approximate thumb to all fingers except little finger. Could close fingers best with hand in dorsal flexion at wrist. Could flex and extend wrist almost as well as on right side, either with palm turned upward or downward. Rotation of forearm about as free on left as right side, although the power was much less. Active flexion and extension of elbow almost as free on left as right side but muscles much weaker. Active abduction at the shoulder to about 100 degrees, passive abduction to about 160 degrees.

The patient returned to work August 28, his work consisting chiefly in chipping iron and steel with a hammer and chisel, the latter being held in the affected hand. At first he had much difficulty in holding the chisel firmly enough, and could not have continued at his work if the foreman had not encouraged him to do so. In about two weeks he could do his work satisfactorily enough. The improvement in the whole limb continued, until in about a

year it was practically normal. He says that for a long time the limb has been about as good as it ever was.

In my opinion, the original injury resulted from forced abduction of the arm at the shoulder, with a laceration of the axillary portion of the capsule, perhaps with a temporary dislocation and immediate reduction as the arm fell to the side. The reparative inflammation extended to the axilla involving the branches of the brachial plexus, and was followed by a contraction of the capsule which accounted for the limitation of abduction and external rotation. The tearing of the contracted capsule and the abducted position of the arm, in some way, were responsible for the rapid improvement which followed, and the exercise of the muscles involved in using the improved motion, which became normal, was chiefly responsible for the return of the power to the normal.

CASE III.—Woman, forty-one years of age, weight last spring 130 pounds, now (September, 1911) 112 pounds. Referred by Dr. B. F. Stahl, who suspects a mild tuberculous lesion in the left lung. No tubercle bacilli in the sputum. In December, 1909, she had a large abscess in the left axilla, which was opened and required about four months to heal. Ever since she has had a severe brachial palsy of the whole limb, most marked in the shoulder region, and marked limitation of abduction and external rotation. Muscles of the whole limb are much atrophied, particularly those about the shoulder, the deltoid being so thin that the upper end of the humerus seems almost subcutaneous. In January, 1911, an effort was made to restore motion to the shoulder by "breaking up adhesions" under ether. Passive movements by a masseuse were continued for a long time but nothing was gained. In November of the same year, I tried the same procedure, but fixed the arm in full abduction for 18 days, after which passive motion and massage were kept up faithfully for about seven months. No improvement in movement or power resulted. Electrical examination by Dr. J. W. McConnell, showed that all muscles of the limb responded to the faradic current. I still believed that if I could restore the normal motion to the shoulder, the patient would recover much of her former power, and I proposed a plastic operation on the scar tissue in the axilla to overcome its effect in restrict-

ing motion. She returned in October asking for the operation, which was performed at the Howard Hospital, November 14, 1912. The arm was fixed at a right angle on a splint for three weeks. Soon afterward she began mechanical treatment in the orthopædic gymnasium of the University Hospital, for which privilege I am indebted to Professor G. G. Davis. This treatment was continued until June, 1913, when she left for her summer vacation. She could then raise her arm straight above her head, by anterior elevation but could not raise it as far by lateral elevation. The improvement in power was general in the whole limb and was still continuing. She could play on the piano, could swing light Indian clubs, and do many other things that she had not been able to do since before the axillary abscess had developed.

As I view this case, the axillary abscess resulted in essentially the same condition as the shoulder-joint injury in the preceding cases, except that in this one the involvement of the branches of the brachial plexus in the scar tissue produced a more severe and unyielding condition than is usual after the joint injury. The release of the nerves from this dense scar tissue must be a slow process. How much return of power will ultimately occur, remains to be seen.

Posterior subluxations of the shoulder-joint associated with obstetrical palsies are only now beginning to receive the attention they deserve. Fairbank says, "Anatomically, there is no doubt about the subluxation." He has notes of 40 cases of obstetrical palsy seen during the last few years, 35 of them in the "last three years or so," and of the subluxation he says it "has received little or no attention in this country" (England). Excluding three of his 40 cases, seen before the subluxations were appreciated, 28 of the remaining 37, or 76 per cent., showed subluxation of varying degree. Nine out of my 12 cases, or 75 per cent., showed subluxation. That they have received little attention is to be accounted for by the fact that they are peculiarly obscure (see Figs. 1, 2 and 3). I had never had any particular interest in obstetrical palsies until I realized that they were generally supposed to be due to the same cause as the

adult brachial palsies from injury to the shoulder region. I then sought a case for study and this was furnished me by the kindness of Dr. R. H. McCombs. I approached the case with the thought of its having, possibly, a shoulder-joint origin. Although a peculiarity in the conformation of the shoulder immediately attracted my attention, it was some time before I realized that the patient had a posterior subluxation of the shoulder. I also realized, at that time, that there was something peculiar about the anterior part of the shoulder, the real nature and significance of which I could not interpret. From my study of this case, as already reported, I concluded that the dislocation was probably the cause of the palsy or pseudopalsy. The cases which I have since seen, have only confirmed that view. In seeking important papers, I did not look up congenital dislocations of the shoulder and for that reason overlooked Whitman's very important paper on this subject.⁶ He called attention to the frequent association of these congenital dislocations with obstetrical palsies. He regarded most of them as being secondary to the paralysis resulting from an injury to the brachial plexus. Fairbank supports Whitman's view. F. Lange who supports the shoulder-joint origin of most obstetrical palsies, disputed the existence of dislocation in these cases.

The theory that these palsies are due, uniformly, to rupture of fibres of the brachial plexus had its origin and became firmly established without taking into account these frequent subluxations. I cannot agree with Whitman and Fairbank that the dislocation is due to the paralysis, but prefer to believe that the paralysis is due to the dislocation, and that the term, pseudopalsy, applied to most of his cases of obstetrical palsy, by Lange, serves a useful purpose. If this can be proved, then it follows that if the dislocation is recognized and completely reduced early enough, in most cases there will be a complete return of function and growth of the affected limb. The chief responsibility will then lie with the obstetrician and family physician.

⁶ ANNALS OF SURGERY, 1905, xlv, p. 110.

To prove this the essential thing is to show that the dislocation occurs at birth and is traumatic in origin. While it is possible to have a dislocation and a rupture of the brachial plexus occur at the same time, this is not likely or, at least, is not likely to be frequent. We have no positive evidence that the sublaxations are due to paralysis. Stimson, like Whitman, included under congenital dislocations of the shoulder, all dislocations present at birth or developing as the result of injury to the brachial plexus, and, like Whitman, regarded the true congenital dislocations as rare. But while Whitman considered those secondary to an injury to the brachial plexus, as the most frequent, Stimson⁷ thought it probable that the most frequent variety was due to force applied to the shoulder at birth. He had 5 cases, all backward dislocations; four of them, possibly all, occurred at birth. Both Whitman and Fairbank say that the shoulder-joint is injured at birth in some cases, and Fairbank states that it would be impossible to say that the dislocation did not occur, in some cases, coincidently with the plexus injury at birth. In one of his cases, the physician who was present at the birth of the patient, diagnosed the dislocation of the shoulder at that time, but Fairbank concluded that the physician must have been mistaken. In 5 of his 28 cases with sublaxation, he completely reduced the dislocation without operation. The earliest period at which he has seen a reducible sublaxation was 2 months. The dislocation in this case had probably existed some time previous to the reduction, which brings its origin close to birth. Of the 28 cases, 14 were in the first year of life. In 18 of the 28, electrical examination, under an anæsthetic, showed no signs of paralysis. Of the 10 remaining, 7 showed only some weakness of the extensors of the back of the hand. It will be seen, therefore, that in at least four of his cases, the paralysis had entirely disappeared within the first year of life, and in 11 it had almost entirely disappeared. A paralysis which disappeared so soon, could hardly be expected to produce, secondarily, a sublaxation of the shoulder that would be irreducible without operation.

⁷ Fractures and Dislocations, 1907, p. 610.

I have had only nine cases of obstetrical palsy with subluxation which, I confess, is a small experience upon which to base a dispute concerning the obscure etiology of these cases. I believe, however, that there is in every one of these nine shoulders positive evidence that the subluxations developed at birth from direct pressure against the anterior portion of the shoulder pushing the humeral head backward. It should be borne in mind that these subluxations have been, practically, overlooked until recently. Close observations of them have not yet been reported. In my second case the subluxation was easily recognized although it was of milder grade than in the first, but as in the first I was conscious of the fact that there was something peculiar in the conformation of the shoulder which I did not understand. I was imbued with the idea that all that was necessary was to reduce the dislocation and from my operative experience in the first case, I was convinced that the chief obstacle was connected with the alteration in the glenoid cavity and with the anterior portion of the capsule. I met these conditions in operation on this second case by dividing completely the anterior portion of the capsule and removing the upper anterior margin of the glenoid cavity. Although I restored much of the restricted abduction and external rotation, and the function and development later improved remarkably, I did not completely reduce the dislocation. This became more obvious in the after-treatment when I could palpate the shoulder freely without pain to the patient, and it was then that I discovered what I believe will throw a new light on the subject of obstetrical palsy. If the examining finger is passed from behind over the upper surface of the acromion, on the normal side, it will come upon the rounded upper end of the humerus just in front of the anterior edge of the acromion. By the same manœuvre on the affected side, the finger will not find the smoothly rounded upper end of the humerus, just in front of the acromion. What I had not recognized before was that the anterior portion of the acromion was bent downward and as the finger passed forward it continued in contact with this portion of the acromion a slight distance

downward (see Fig. 1 *a* (*A*), and Fig. 4 (*A*). This change in the shape of the acromion was present in varying degree in all nine of my cases with posterior subluxation.

My only purpose at present is to call attention to its presence and to its probable significance. I am not prepared to describe the deformity in detail because its characteristics vary. This is probably due to the fact that the pressure which is responsible for it is not always applied exactly in the same place. The most important variation was found in my last case, in which the posterior dislocation was more marked than usual. The downward projection of the anterior portion of the acromion was slight or absent and merely changed the normal inclination of the acromion from the anterior margin downward and backward, so that it was horizontal or slightly curved from before backward, which showed that the anterior portion had sustained pressure from above. In this case, however, there is evidence that the coracoid process had received considerable pressure. Efforts to show the deformity by the X-ray have not been satisfactory (see Figs. 5, 6, and 7) ⁸. This may be due in some cases to the fact that the abnormal portion of the acromion is cartilaginous as shown by operation in two cases, and in others to the difficulty in bringing out by the X-ray the difference between the normal inclination of the acromion and the change produced by the pressure. As one would expect

⁸ The downward projection of the acromion which is easily palpable and even visible in Case I—Fig. 1 *a* (*A*) and Fig. 4 (*A*)—is not shown in the skiagraph (Fig. 5, right shoulder). In Case II it is easily palpable and its borders can be outlined, yet it scarcely shows in the skiagraph, Fig. 6 (right shoulder). In Case VIII it was not present although the acromion seemed depressed as a whole and was more horizontal than on the normal side. There is shown in all three cases, by the X-ray, a change in the plane of the acromion. On the normal side it is seen as a thick plate of bone, due to its inclination downward and backward from its anterior to its posterior border. On the affected side, in all three cases, it appears to be thinner, indicating that it occupies a more horizontal plane, which is to be explained by a downward pressure on the higher anterior portion, during birth. Figure 5, right shoulder, seems to show that the humeral head and acromion have been largely worn away, by rubbing against each other during movement. In the normal or left shoulders, the lower margin of the shadow of the acromion marks the posterior margin. This is not so

a

FIG. 1.

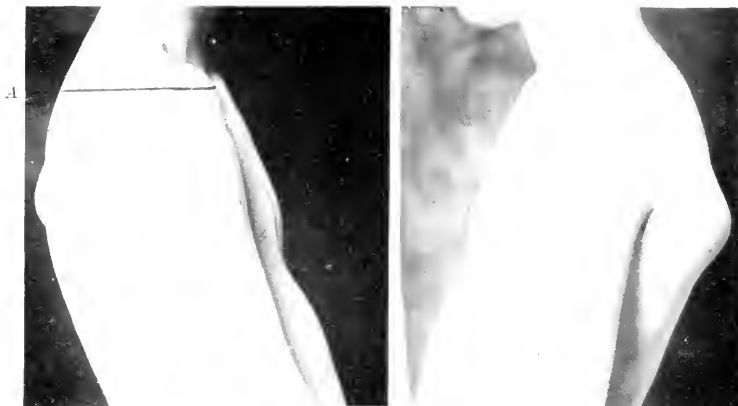
b*a*

FIG. 2.

b*a*

FIG. 3.

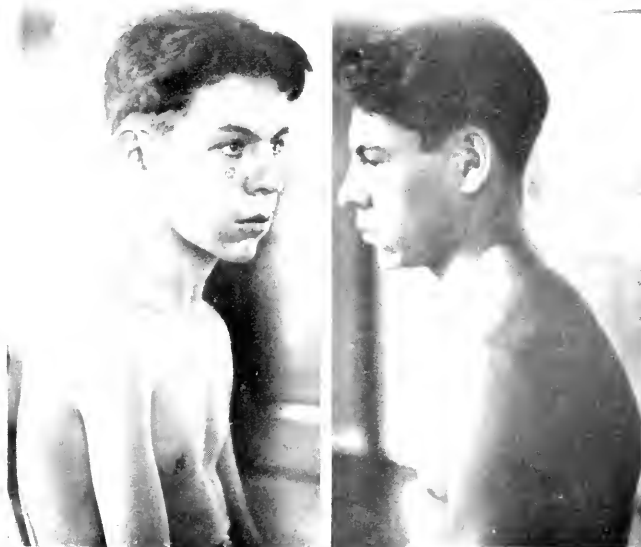
b

Fig. 1 (Case I), Fig. 2 (Case II), and Fig. 3 (Case VIII) illustrate the mild grade of posterior subluxation in the right shoulder, which is shown by the slight flatness anteriorly. Fig. 1a, A shows the turning down anteriorly of the acromion. The acromioclavicular joint is obviously involved in this case. It is the only case in which the bending down of acromion can be seen.

FIG. 4



Case I. Comparison between the two shoulders discloses a flatness anteriorly in the right one. The turning downward of the acromion is faintly discernible at .1. In the other cases careful palpation was necessary to detect it. In this case there is a bony protuberance at the acromioclavicular joint which accounts for the diagnosis of fracture of the clavicle at birth.

FIG. 5a.



Case I. Right shoulder.

FIG. 5b.



Case I. Left shoulder.

FIG. 6a.



Case II. Right shoulder.

FIG. 6b.



Case II. Left shoulder.

FIG. 7*a*.



Case VIII. Right shoulder.

FIG. 7b.



Case VIII. Left shoulder.

FIG. 8.



FIG. 9.



Figs. 8 and 9 show degree of active elevation of arm. Mechanical obstruction and not lack of power prevents greater elevation. Patient shown in Fig. 8 has the better development and use of the limb.

FIG. 10.



Case III. Posterior subluxation at shoulder and anterior dislocation of radius at elbow. Marked compensatory hypertrophy of whole left limb, probably due to unusual helplessness of affected limb.

FIG. 11.



Case VI. Shows limitation of extension at the right elbow, which is about the same in Case IV and in one case without subluxation of the shoulder. Comparison with the other arm shows the internal rotation.

FIG. 13.



FIG. 14.

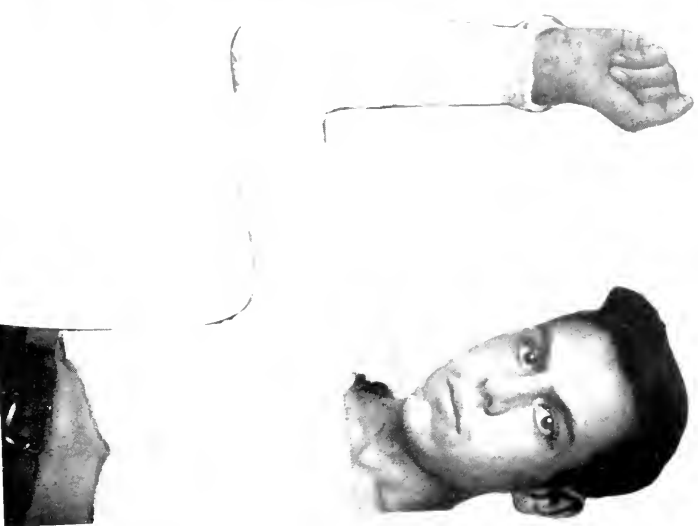


FIG. 12.



CASE II.

CASE V.

FIGS. 12-14.—Three different positions in which the limb was dressed after operation.

CASE VIII.



FIG. 15.



Case VIII. Atrophy of whole limb marked, of shoulder and arm muscles more marked than in any of the other cases. The higher of the two prominences seen anteriorly is the edge of the acromion, the lower the coracoid process.

from the fact that the deformity has been overlooked, it is an obscure one. A careful examination is necessary to establish its presence and outlines. The downward projection of the acromion seems almost to fuse with the upper end of the humerus and it is a little difficult to determine when the examining finger is on this portion of the acromion and when on the humerus. It is most evident in the older patients and in them seems to be ossified.

The explanation for it seems obvious. For my cases, at least, it offers positive evidence for what Stimson had already suggested, *i.e.*, that most of the congenital dislocations of the shoulder are probably the result of direct pressure backward on the humeral head by the bony wall of the maternal pelvis, during birth. He says that some of the paralytic forms have been described as "obstetrical paralyses." He also says: "In my four cases, Scudder's two, and Cumston's, the right arm was affected, in Gaillard's the left; and it seemed possible that as the right shoulder is in front in the great majority of births, the cause might be its pressure against the arch of the pubis. Against this or, at least, limiting it, is the double dislocation in Küstner's and the breech presentation in one of mine." My cases furnish a striking confirmation of Stimson's observation. In 11 out of my 12 obstetrical palsies, the right arm is involved.

certain on the affected side. If on this side the lower margin in the skiagraph represented the anterior border, it would mean that this has been bent downward.

A mild downward displacement of the humerus is shown in the three cases. The posterior displacement cannot be shown by this exposure and only with difficulty by any other. Note the absence of the separation between the clavicle and acromion on the affected sides. Figure 5 (right shoulder) seems to show complete fusion of the two bones. There is a bony protuberance at the site of this joint in this patient. The same union of the two bones seems to be shown in Figure 6. In Figure 7, the outer end of the clavicle can be faintly traced, indicating that bony union is not present in this case. The X-ray shows clearly that these are not cases of epiphyseal separation. The small range of movement in the affected shoulder of Case VIII might account for the nearly normal shape of the humeral head (Fig. 7), and probably accounts for much of the atrophy of the muscles (see Fig. 15).

Fairbank, however, says of his cases that "The two arms were affected in an equal number of cases."

The dislocations of the shoulder in the adult are almost always anterior, those associated with obstetrical palsy are practically always posterior. The only autopsy report on a congenital dislocation of the shoulder, found by Stimson, was of a double anterior dislocation reported by R. W. Smith.⁹ After reading Smith's paper, published in 1847, I would agree with Stimson that in all probability this was not a case of congenital dislocation. In my opinion, the great majority of dislocations of the shoulder in adults are anterior because they are due to hyperabduction, which can produce only an anterior dislocation. The few posterior dislocations that do occur in adults, are probably due to direct violence pushing the humeral head backward. The fact that practically all dislocations of the shoulder occurring at birth are posterior, is probably to be accounted for by the same mechanism, as the child is coming through the birth canal. Lange, in discussing Finck's idea of a preglenoid dislocation in these cases, maintained that a dislocation of the shoulder, to occur at all, must be complete, and that such a dislocation in the new-born could be shown by the X-ray. Neither Finck, nor any other writer, he says, has established in this way, a dislocation of the shoulder in the new-born. He adds that the application of strong force during birth would result rather in an epiphyseal separation than in a dislocation. There would be much force in these statements, if we ignored the fact that all dislocations are not produced in the same way, and this fact has not received much attention. The anterior dislocations are the result of indirect violence exerted through hyperabduction of the humerus and the first strain at the shoulder comes on the axillary portion of the capsule which must tear before a dislocation can take place. I have tried in several infant cadavers to produce an anterior dislocation by hyperabduction and have obtained each time an epiphyseal separation or a fracture of the upper end

⁹ Fractures and Dislocations, 1847.

of the humerus. The capsule was stronger than the humerus as suggested by Lange. Direct pressure backward on the head is not likely to fracture it. The X-ray will not show a typical dislocation of the shoulder in these subluxations, because they are not typical as we know dislocations (see Figs. 5, 6 and 7). The X-ray will, however, show a slight downward displacement, and a change in the normal shape of the head, probably due to abnormal pressure and retarded growth. I agree with Lange, for the ordinary dislocations in adults, that they must be complete. The humeral head cannot remain resting on the glenoid margin in the subluxated position. It must glide over into the completely dislocated position or back to its normal place in the socket. But in these posterior dislocations associated with obstetrical palsies the head remains resting on the posterior edge of the glenoid cavity in the subluxated position because of the obstructing anterior portion of the acromion bent down by the same force which pushed the head backward at birth, and possibly by a coracoid process that was also pressed downward and backward. The head cannot jump back into the socket because of this obstacle. Here is a very satisfactory explanation for some of the obstinate difficulty in reduction, encountered by Whitman and Fairbank, and which I found in four of my cases. Other obstacles develop in time, as from contracted muscles and other soft tissues and changes in the head of the humerus and glenoid cavity. In the early stages this abnormal portion of the acromion may be the only serious obstacle to reduction. In one of my cases, a boy ten months of age, I removed this obstruction and then had little difficulty in accomplishing the reduction or in maintaining it. In two other cases complete reduction could not be accomplished even after removal of this obstacle. Since this abnormal condition of the acromion was present in all nine of my obstetrical palsies with posterior subluxation, I have no doubt that it will be found by others.

In looking for the subluxation, the best sign, is the absence of the normal prominence of the upper end of the humerus, in front of the acromion, as determined by the palpating finger,

together with the presence of an abnormal prominence just below and behind the posterior margin of the acromion. The degree of displacement varies considerably in my cases, although in none is the dislocation complete. The amount of fat and the mild grade of displacement, may make the conformation of the shoulder so nearly normal that the subluxation will be overlooked unless one has in mind the possibility of its presence and makes a careful examination. I overlooked it in two of my early cases.

If a dislocation of the shoulder in the adult produces a brachial paralysis without rupture of nerve fibres, a dislocation in the new-born is much more likely to do so because of the much more delicate and sensitive muscles and nerves. This will account, I believe, for an interesting difference between the two groups of cases. In the new-born the paralysis seems to be complete in most or all cases for a time. In the adults, it is rarely complete. In both there is usually a tendency to rapid improvement. In a case, without dislocation, seen with Dr. L. C. Peter, about six weeks after birth, the palsy had almost entirely disappeared, yet immediately after birth the palsy was complete, according to the statement of Dr. Peter, who is a neurologist of experience. It is generally agreed that in the majority of cases, the paralysis spontaneously recovers. Reports of cases in which the extent of the paralysis is made evident by electrical examination, are conspicuous by their infrequency, and in this respect they are very similar to the adult brachial palsies from injury to the shoulder region. Fairbank found that in most cases the paralysis had largely disappeared by the end of the second month, as determined by electricity. In his series of 40 cases, the nerves appeared to have completely recovered or showed every sign of recovering at the time of his report in, at least, 60 per cent. of the cases. In several of the remaining 40 per cent., the residual paralysis affected one or more muscles of the forearm only, the bulk of the paralysis having entirely disappeared. It should be borne in mind that 14 of his 28 subluxation cases were in the first year of life, how many of the other 12 cases without subluxation he does not say. The

inference is that more than 60 per cent. of all his cases recovered from the paralysis completely, at a later period. Sherren says that about 70 per cent. of his cases recovered spontaneously, and that in many the paralysis had completely recovered at the age of three months, before which period he did not test the electrical reactions. But spontaneous recovery from the paralysis does not mean a functional recovery, as in 28 out of 37 of Fairbank's cases, there still remained a subluxation, which is not mentioned by Sherren. I have seen two cases in which the relations of the skeleton were normal at the shoulder and throughout the whole limb. In one case as already stated the child had recovered almost full use of the limb in about six weeks. I have seen this case recently and normal function and development have been present so long that the mother has almost forgotten about the palsy. In another case, now an adult, the patient has had full function in the previously paralyzed limb for many years. She has a clear recollection of the palsy in her early years, but it disappeared so gradually that she does not know now how long it lasted. This suggests what I believe to be true, *i.e.*, if the shoulder-joint relations are normal in a case of obstetrical palsy of the usual type, the limb will gradually recover full motion and function and will have its full growth. In a third case, the sister of one of my patients with subluxation, the shoulder-joint relations are normal, but there is some limitation of extension at the elbow indicating that an injury occurred there at birth. Now the function of the limb is practically normal, and such impairment as still exists is to be accounted for by the limitation of movement at the elbow.

If in an adult the dislocation remains unreduced, the associated palsy gradually disappears, but never completely. After years of persistent effort the power and motion may recover to a remarkable degree. The improvement in motion is responsible for the improvement in power, and the return of normal power is impossible because the return of normal motion is impossible. Stimson gave as one of his reasons for thinking that the most frequent variety of congenital dislocation of the

shoulder was probably traumatic (and not secondary to paralysis), "that the limitations of motion closely resemble those of the similar traumatic dislocations in adults." As I see these cases of obstetrical palsy with posterior subluxation at eight to ten years of age, especially the two which were incompletely reduced about two years ago, they are nothing more than old unreduced dislocations of the shoulder. Such limitation of movement and power as is present, is to be explained by the displacement in the shoulder-joint. Both Whitman and Fairbank believe that sometimes the displacement in the joint is the only obstacle to complete recovery. I believe that this is true of practically all early cases. In long standing cases, permanent changes have taken place, particularly, in the bones, and in some cases there is a marked lack of growth in the limb. Reduction of the dislocation will improve these very much, but of course will not restore the limb to the normal. It cannot be expected to restore the normal shape of the humeral head and glenoid cavity, although these may improve from long continued movement with the bones in normal contact with each other. While the affected limb may be shorter than the other and atrophied, we may expect improvement in size and strength. This has resulted already in my second case operated on, to a very satisfactory degree, and in the first case, the improvement is almost as satisfactory (see Figs. 8 and 9). It is of interest that the displacement in the first is more marked than in the second.

In one of my cases there was the usual posterior subluxation of the shoulder with the bent down condition of the acromion, and in addition an anterior dislocation of the head of the radius (see Fig. 10). Fairbank had a similar case and thought the radial dislocation congenital in origin. I prefer to believe that, like the shoulder dislocation, it occurred at birth and is traumatic in origin. Electrical examination by Dr. J. W. McConnell, did not reveal that any muscle was completely paralyzed, but while the muscles of the arm from the shoulder to the elbow showed the same atrophy and weakness as in the other cases of subluxation of the shoulder at about the same

age, unlike these, from the elbow to and including the hand, the atrophy and weakness were much more marked than above the elbow. This suggests that the muscles from the shoulder to the elbow suffered the usual palsy from a subluxation of the shoulder and from the elbow down they suffered the combined palsy consequent upon the shoulder and elbow dislocations. In Case IV, in addition to a subluxation at the shoulder, there is an abnormal prominence about the radial head and a turning of the forearm inward in the cubitus varus position. In Case VI, there is a considerable limitation of extension at the elbow (see Fig. 11). It becomes more than probable, therefore, that the elbow as well as the shoulder suffers from trauma in some births. In Case III, the hand is fixed in flexion, which I am inclined to ascribe to contraction of the flexors, although I have not had the opportunity of studying this case carefully.

In this discussion, I have not considered two groups of cases, those in which the brachial plexus is injured without flail-joint and those with flail shoulder-joint. I excluded the first because none of my cases seemed to be in that class, and the second or flail-joint type, for the same reason and because they seem to be exceedingly rare. Whitman mentioned the latter, but not in such a way as to infer that any of his cases were of this kind, and Fairbank did not mention them. I have not seen any, nor have I seen a report of such a case in the literature, although my search was not at all thorough. If in a case of obstetrical palsy, I found the anatomical relations at the shoulder normal, no other deformity in the bones of the limb, the sensation normal, and after several months the electrical reactions normal, I would not worry much about the ultimate outcome of that case. Any limitation of movement in the shoulder-joint from contraction of the capsule would gradually disappear, I believe, from persistent manipulations by the mother or nurse, and the normal function of the whole limb would recover, in time, completely or practically so. From my experience and study of obstetrical palsy, it seems to me that we have been paying too much attention to the brachial plexus and too little to the skeleton. Obvious injuries of the

skeleton, like fractures of the clavicle and humerus, both of which were present in one of my cases, receive attention, but the less obvious injuries, especially those of the shoulder-joint, have been largely overlooked. In any case I would look first to the shoulder. If this were the general teaching and practice, I believe that there would be much fewer permanent obstetrical palsies. If there was present a subluxation of the shoulder and the physician in attendance at birth had this possibility in mind, he would probably find it in most cases and would probably reduce it immediately. The palsy would then gradually disappear, although this might require months or years. If the dislocation is first recognized months or years after birth, the first consideration should be to reduce it. But while the condition has received little attention as yet, the work of Whitman and Fairbank show that the subluxation is very difficult of reduction. Of his 28 cases, Fairbank could reduce only five without operation. Whitman, who used the non-operative method of reduction, found that in the more extreme cases it is impracticable to complete the reduction at one sitting. He applied a plaster case after the first attempt and undertook the further correction after an interval of two weeks. In all the cases, he says, there is a strong tendency to return in some degree to the original posture. I have had, as yet, the opportunity of attempting reduction in only five of my nine cases with subluxation. In my first and second I failed to reduce completely by operation. In the third, I tried the Whitman non-operative method of reduction after exposing and removing the obstructing portion of the acromion, and accomplished complete reduction rather easily. But soon after the removal of the case the subluxation recurred and the limb took the position of internal rotation again. It could easily be reduced again by rotating the arm externally. I attribute this result to the fact that the posterior part of the capsule was made longer than normal by the subluxation and was not shortened after the reduction. The abnormal changes in the humeral head and glenoid cavity from the ten months' duration of the dislocation, probably favored the gliding of the head into the dislo-

cated position. I expect later to shorten the posterior part of the capsule and the overlying rotator tendons in this case. (This has been done since the reading of the paper.) In my fourth attempt at reduction, I merely removed the obstructing portion of the acromion, without shortening the posterior part of the capsule and rotator tendons, because I was satisfied that this would not suffice to hold the head in its normal position in internal rotation which, in this case, forced the head into the subluxated position every time against any resistance I could safely offer. The humeral head was much altered in size and shape and I preferred to permit a greater range of movement at the shoulder, *i.e.*, of the head from the normal position to the subluxated, in the effort to obtain a wider range of movement of the arm in external rotation and abduction. The findings in the fifth case differed also from the others. As we are only now beginning to appreciate the frequency of these subluxations, the best method of treating them has not yet been worked out. It is likely that immediately after birth non-operative reduction will be easy, that the difficulty will increase as the child grows older and the prospects of complete recovery grow less. My first two cases, which I have been able to watch for two years or more, and particularly Case IX, show that after years much improvement in motion and power can be obtained. It is of much importance that these young patients can afford to wait a long time for the gradual return of power.

Lange in 8 cases, following Hoffa, improved the usefulness of the arm, especially external rotation, by doing an osteotomy below the middle of the shaft of the humerus and obtaining union with the lower fragment in external rotation. The object was to overcome the obstinate internal rotation. The operation was followed by much improvement; for instance children, who could carry the arm only to the waistline before operation, learned to comb the hair, carry the hand to the mouth, button the clothes at the back, etc. But my patients, even after incomplete reduction of the subluxation by operation, showed much more improvement than this, they could

carry the hand higher and had nearly full external rotation. Case IX with a mild subluxation has recovered almost a normal arm from exercises alone, without reduction of the subluxation. Osteotomy does not improve motion of the arm, which can only be done at the joint, but merely improves external rotation at the expense of internal rotation. It should be borne in mind that Lange attributes the limitation of movement at the shoulder, to an epiphyseal separation of the upper end of the humerus, in these obstinate cases. I have no doubt that the existence of subluxation in these cases, will become generally recognized, when it will become obvious that the best place to improve the movement of the arm, is at the shoulder-joint and not at the middle of the humerus.

Conclusions.—In the great majority of cases of obstetrical palsy of the upper extremity, the primary cause is not rupture of the brachial plexus but an injury to the shoulder-joint, the plexus and its branches becoming involved in the adjacent axillary inflammation. Electrical examinations will fail in most cases to demonstrate actual nerve paralysis after two or three months and before that time they are not advisable (Fairbank and Sherren). Detailed reports showing accurately the extent of the nerve paralysis by electrical examination, are conspicuous by their infrequency.

In most of the cases in which the brachial plexus has been exposed by operation above the clavicle, rupture of the plexus has been assumed because of the presence of adhesions about the plexus and thickening of the cords. The very few cases in which the roots have been found ruptured, need further confirmation because of their very small number and because of the great difficulty in dissecting accurately the delicate and interweaving roots. Fairbank, evidently, experienced this difficulty and Boyer, in an autopsy, found the plexus impossible of good dissection because of the abundance of tough adhesions. The presence of these adhesions is best explained, in my opinion, by the extension a few inches upward of the

blood, synovial fluid and inflammatory exudate, from an injured shoulder-joint. Lange by operation in the axilla, found the cause of the paralysis to be the embedding of the branches of the plexus in thick connective tissue in the axilla, and found also a diminution and deformation of the head of the humerus.

The best evidence showing the primary cause of these obstetrical palsies is only now becoming properly recognized, *i.e.*, the frequent association with an obstetrical palsy of a posterior subluxation of the shoulder-joint. The presence of the bent-down condition of the acromion cannot be explained on the basis of a brachial plexus injury and, in my opinion, will prove to be the key to the whole situation (change in the shape of the coracoid process may also result from the pressure). Its presence in all of my cases with posterior subluxation, makes it practically certain that it and the subluxation are due to direct pressure by the maternal pelvis during birth and that the joint injury is the primary cause of the palsy. The most striking evidence of a shoulder-joint origin of the palsy in my cases is afforded by the progress of the condition in them after the improvement of the joint condition. The nine cases in which a more or less severe palsy was permanent, showed a posterior subluxation of the shoulder-joint in each. In two of the three cases in which there was no subluxation, full function has returned. In the remaining case, there is full power of all the muscles and full motion of all the joints, except the elbow, the only impairment of function being due to the limitation of extension at the elbow.

Immediately after birth the reduction of the subluxation will probably be easy. After a few months it becomes very difficult, probably because of the obstruction offered by the bent-down portion of the acromion, possibly change in the coracoid process, and by the changes in the surrounding soft tissues. When the abnormal portion of the acromion becomes ossified, it should prove to be a practically insuperable obstacle. The first indication at any stage is to reduce, the next to obtain the best possible motion at the shoulder-joint.

Obstetrical palsy without dislocation, in most cases, will be associated early with limitation of abduction and external rotation which will gradually disappear, the rapidity depending upon the force applied in stretching the contracted capsule and other soft tissues. The palsy will also gradually disappear but will continue for some time after the motion is complete. If an existing subluxation is reduced immediately after birth, complete recovery will probably follow in the same way. If reduced later, complete recovery will be prevented according to the degree of permanent change in the bones and other tissues from the continuance of the subluxation. The condition which develops is very similar to that associated with an old unreduced dislocation of the shoulder in an adult, the lack of growth being due chiefly to the interference with function during the growing period.

The chief responsibility in these cases, according to my view, will fall upon the physician in attendance at birth. The failure to recognize the frequent occurrence of these subluxations is due to their peculiar obscurity, but when once suspected they can be detected by careful examination. The recognition of the absence of the humeral head or tuberosities immediately in front of the acromion and of the presence of an abnormal prominence behind the acromion, is sufficient for diagnosis. The association of anterior dislocation of the head of the radius, abnormal prominence of the radial head, limitation of movement in the elbow, as found among my cases, indicate that the elbow is also subject to injury at birth. Injuries of the skeleton of the upper extremity, associated with obstetrical palsy, offer a fruitful field for further study. I fully agree with Lange when he says that "the day for the let alone treatment of obstetrical palsy has passed by."

In conclusion I wish to express my indebtedness to Professor G. G. Davis for his encouragement shown in the transferring to me of three cases with posterior subluxation from his service in the University Hospital, and to Dr. J. W. McConnell for his interest and assistance, as a neurologist, in my cases and in other phases of the work.

CASES OF OBSTETRICAL PALSY WITH POSTERIOR SUBLUXATION OF THE SHOULDER-JOINT.

CASE I.—Reported in *ANNALS OF SURGERY*, January, 1911.

CASE II.—Girl, ten years of age, referred by Dr. A. G. Tinney. Has been reared by grandparents and nothing is known of the birth except that the right arm has been palsied since. It is very little shorter than the left, but is much atrophied, held in marked internal rotation, and can be rotated externally only to a slight degree. Can carry the limb at the side of the body, but when unconscious of being observed, as at play, the forearm is flexed in front of the body, the arm is held in slight abduction and the shoulder is depressed, which position attracts attention to the crippled condition. Cannot flex elbow to a right angle, can abduct arm at shoulder to about a right angle but passive abduction cannot be carried much further. Seems to have some power in all the muscles of the limb, but all are weak, some weaker than others, dorsal flexion of the wrist being particularly weak. She generally uses her left hand because of the difficulty in using the right. For instance, she cannot raise her hand high enough to write on the black-board at school, except with much straining, and when she does the whole limb trembles and her writing becomes illegible. The anterior and outer portion of the acromion is bent downward and seems to be almost directly in contact with the humerus, but this was not observed until after the operation.

Operation (August 8, 1911).—At University Hospital, in service of Professor Edward Martin. With arm in abduction, capsule exposed by axillary incision between coracobrachialis muscle and large vessels and nerves, and subscapularis muscle divided. Capsule opened anteriorly from upper to lower part of joint. Finger in joint felt nothing abnormal except poorly developed and irregular head. Anterior and upper portion of glenoid margin removed with gouge and scalpel, to permit the head to be pushed upward and forward to its normal place, but this met with only partial success. Almost full external rotation was obtained. Patient then turned over and posterior portion of capsule exposed by incision along posterior margin of deltoid and division of tendons of infraspinatus and teres minor. Capsule divided, head pushed upward and forward, and an effort made

to hold it there by shortening of the capsule and divided tendons. Anterior part of capsule and subscapularis muscles sutured, and then both skin wounds, a small drain being left in each. Dressings. Arm fixed in full abduction and external rotation by a plaster case. Both drainage tubes removed in 48 hours, and primary healing obtained. Case removed August 20 and arm brought to side of body, gradually by changing the angle of fixation. When all fixation was removed, there was a severe palsy of the whole limb, but sensation was good throughout. Could flex and extend little finger and thumb, but could not move other fingers. Could not flex or extend elbow or rotate forearm. This palsy gradually disappeared and in about six weeks the power was better than before the operation. At the present time it is almost as good as in the left, and she has schooled herself to use it in preference to the left, although there is still considerable mechanical obstruction to movement at the shoulder, probably due chiefly to the bent-down condition of the acromion against which the humerus impinges, and to the incomplete reduction of the dislocation. Whereas before operation her crippled condition was apparent, practically all the time, it is evident now only when she raises both arms up above her head.

CASE III.—Boy, nine years of age. Referred by Dr. H. D. Beyea. Birth difficult, lasting about 60 hours, instruments finally being employed. The physician who delivered the mother, told her that the shoulders were very broad and that, in using instruments, he had pulled so long and hard that he was exhausted. Paralysis of right arm noticed by nurse during first bath. The only deformity noticed at the time, by the physician, was a turning inward of the left foot, which soon disappeared without treatment. As the child grew the whole right upper extremity gradually became shorter than the left, but developed some power in various parts. It is now atrophied as a whole, but much less above the elbow than below. There is a posterior subluxation of the shoulder, and a complete dislocation, anteriorly, of the head of the radius (See Fig. 10). This dislocation can be reduced almost completely, but recurs quickly when the pressure is removed. The anterior portion of the acromion is bent downward. There is a very marked compensatory hypertrophy of the whole left upper extremity.

At the University Hospital, January 22, 1912, an operation

was done to prevent recurrence of the radial dislocation. The radial head was nearly normal in shape as was the capitellum of the humerus. The lesser sigmoid cavity of the ulna had lost its normal concavity and was somewhat convex, and there was an abnormal prominence on the ulna just below. This was removed, the lesser sigmoid fossa reshaped with a chisel and curette, and the soft tissues cut away to permit the radial head to occupy its normal position. It was held in place by overlapping of the divided orbicular ligament. Wound closed. Fixation of limb at a right angle by an anterior splint. Primary healing. Splint removed on nineteenth day. February 17, 1913, there was improvement in gripping power of hand, and slight rotation of forearm, which parents had never noticed before operation. When I saw the patient again a few months later, the dislocation of the radius had recurred and all improvement in power of limb had stopped. My object had been to prevent recurrence of the elbow dislocation with the hope that it would be followed by a sufficient return of power in a few months to warrant the attempt at correction of the shoulder dislocation. The failure with the elbow condition caused the parents to decline further interference. If I had had a second chance to operate, I would have excised the head of the radius, and if permitted, would have attacked the shoulder later.

CASE IV.—Boy, four months and three weeks old. Obstetrical palsy of right arm, with posterior subluxation of shoulder and turning down of anterior and outer portion of the acromion. Mother very obese. Has had four children and all were delivered with instruments, but the birth of this child was the most difficult of all. After the head was born there was considerable difficulty in delivering the rest of the body, particularly, the right or now palsied arm. Immediately after birth the child was much cyanosed and recovered its normal color only after some effort and time. The paralysis of the right arm was observed soon after birth and was complete. There has been very little return of power since. For past five weeks, has been receiving electrical treatment in the nervous dispensary of the University Hospital, by Dr. J. W. McConnell, and seems to have improved faster in that time. The patient had been referred to the nervous dispensary from the orthopædic department, by Professor G. G. Davis, who later turned it over to me. The child could lift the

whole limb forward about 30 degrees. There was a well-marked wrist drop, but it was not noted at this time that there was any fixation of the wrist in flexion. There were no movements in the fingers except very slight when the palm was tickled. There was marked limitation of passive abduction and external rotation at the shoulder-joint. These notes were taken October 25, 1911, the first time I saw the child, but the parents did not return with it, and I did not see it again until August 18, 1913, when I looked it up to learn what its condition was. There had been a considerable improvement in power in the whole limb, although it was still a much crippled limb. Voluntary abduction at the shoulder to about a right angle, and passive to about 160 degrees. According to my recollection and the statements of the parents, this was a considerable improvement. The whole limb was still held in marked internal rotation and passive external rotation was very much limited. There is an abnormal prominence of the head of the radius and the forearm is turned inward in the cubitus varus position. There is some limitation of extension at the elbow. The hand occupies the wrist drop position and cannot be extended passively to the straight position, although there is considerable gripping power in the hand. The parents are not yet disposed to permit anything to be done to the limb.

CASE V.—Boy, ten months old, referred from orthopædic department to nervous dispensary of University Hospital, to be examined by Dr. McConnell, and then to me. Weight at birth said to be 13 pounds. Mother small, weight 108 pounds. Birth difficult. Head presentation. Instruments used. Right arm completely helpless immediately after birth. Now has characteristic internal rotation of whole limb, and passive abduction is much limited. Can hold light objects in hand. Has a little power in wrist and elbow, and raises limb at shoulder almost to horizontal. Atrophy of whole limb, but not extreme, and limb slightly shorter than its fellow, which seems to show slight compensatory hypertrophy. Normal angle on outer side at elbow is lost. Dr. McConnell observed a mild grade of posterior subluxation at the shoulder, which is evident only on careful examination. He also thought he detected a turning downward of the anterior and outer portion of the acromion, which I was satisfied I could feel, but the mild grade of dislocation and the amount of fat made the shoulder so nearly normal in conformation that it

would be necessary to have the possibility of the subluxation in mind and to examine carefully for it in order to find it.

The patient was etherized at the University Hospital, in the service of Professor Edward Martin, August 7, 1913. The subluxation was now more obvious and the bent-down condition of the acromion readily felt. By manipulating the lower end of the humerus outward in abduction and backward with the right hand, and using the thumb of the left hand as a fulcrum behind the humeral head, the latter was forced almost if not to its normal position where it could be felt in front of the acromion. It was evidently covered in great part by the abnormal portion of the acromion, which obscured it. When the pressure was removed, the subluxation quickly recurred. An incision was made about an inch and a half long, along the anterior portion of the acromion. This exposed a triangular projection of the acromion downward for about three-quarters of an inch, which was cartilaginous. The deltoid was detached from its margins, when it was easily pushed upward by the handle of the knife. The humeral head was then rather easily pushed forward and upward to its normal position, when there was a considerable gap between the cut margin of the deltoid and that of the abnormal portion of the acromion from which it was detached. As this was easily bent upward it was not removed except for about a half inch of its tip, and no attempt was made to close the gap between it and the detached deltoid. The skin wound was closed by catgut sutures, a dressing applied, and the limb fixed by a plaster case, with the arm at the side, the elbow in right angle flexion and a little posterior, and the humeral head pushed upward and forward to its normal position. The case was removed August 28, and the arm allowed to hang at the side. The humeral head was in good position. Six days later, the arm hung in the internal rotation position and the head was in the subluxated position, although by external rotation it easily took the normal position. It seems obvious that the posterior portion of the capsule must be shortened before the humeral head will be prevented from slipping back into subluxated position. I had hoped that this shortening would have resulted from the traumatic inflammation following the efforts at reduction and the rest in the fixed position. The change in the bones from the long continued pressure in the abnormal position probably had something to do with the tendency to recurrence of the

subluxation. (The posterior portion of the capsule and overlying rotators have been shortened since the printing of the paper.)

CASE VI.—Referred from orthopædic department to nervous dispensary of University Hospital and then to me. Boy, five years of age. Birth difficult. Instruments used. The attending physician told the mother that the arms were engaged over the child's head in what he called a "locked labor." A neurologist diagnosed a rupture of the brachial plexus and told the mother that it was the most complete he had ever seen. He exhibited the case before a society, when the child was a few weeks old. There is a posterior subluxation of the right shoulder and the anterior portion of the acromion is bent downward. There is marked limitation of external rotation and of abduction, the limb being held in internal rotation. It is considerably shorter than its fellow and there is some limitation of extension at the elbow (see Fig. 11). The hand is held in dorsal flexion and can be flexed, passively, only to the straight position. Has considerable grasping power in the hand and can raise the whole limb forward about 45 degrees at the shoulder. He seems to be unable to move the wrist or elbow, but in his efforts to do so he raises his whole limb from the shoulder and the wrist and elbow are held rigid. This rigidity and the contractions of the muscles of the arm and forearm which can be seen and felt show that he has considerable power which he cannot use.

Operation (at the University Hospital, September 4, 1913, in the service of Professor Edward Martin).—Semilunar incision along the margin of the acromion about $2\frac{1}{2}$ in. long. Anterior and outer portion of the acromion bent downward. It was cartilaginous and when the deltoid was detached from it, was bent upward easily to a level with the bony portion of the acromion. A good exposure was obtained of the upper end of the humerus through the wound. After repeated manipulations the head could be pushed upward and forward to its normal level with the arm in internal rotation, but could not be held there when the arm was turned in external rotation. There was strong resistance to external rotation until the subscapularis, some fibres of the coraco-humeral ligament and some of the lower fibres of the pectoralis major were divided, and considerable force was employed to overcome the remaining resistance. This resistance seemed to come chiefly from contracted soft tissues, including the

capsule and tendons, but the exact seat of the resistance could not be determined. Plain catgut sutures were passed through the skin and deltoid to close the wound. Dressing applied and arm fixed in abduction to a right angle and in full external rotation. Healing by first intention. Arm still in case.

CASE VII.—Boy, three years old. Difficult labor, but instruments not used. Complete palsy of right arm at birth. Much pain on moving arm from side in first few weeks. I saw this child about two years ago, going to its home for the purpose and finding the parents, who were foreigners, hostile to my desire for an examination. An operation on the brachial plexus had been advised soon after birth, and the power and movement of the limb had improved very much without it. My examination at that time did not develop a dislocation. Recently I traced the case to another part of the city, and found that the power of the limb was much improved. The mother states that it is not much below that of the opposite one. There was still, however, considerable limitation of abduction and external rotation in the affected shoulder, and on examination of it at this visit I discovered a mild grade of, but distinct, posterior subluxation with a bending downward of the anterior portion of the acromion. The improvement in power was so marked and so general that it seemed to me evident that the shoulder-joint condition was the only obstacle to complete recovery. My failure to recognize it in my first examination is easily explainable. It was only the second case of obstetrical palsy that I had seen and the subluxation was of much milder grade than in the first which I regarded as mild for a dislocation of the shoulder and which had never been recognized before, although the boy was then $7\frac{1}{2}$ years of age. It emphasizes the obscurity of the deformity and the necessity for care in the examination.

CASE VIII.—Boy, sixteen years of age. Difficult labor. Instruments used. Child was much cyanosed and recovered with difficulty. The physician in attendance said that the arm was broken, but he did not immobilize it. He advised rubbing with alcohol and said that the child would outgrow the palsy which affected the right arm from birth. At about eighteen months of age he was taken to a consultant who recognized a dislocation of the shoulder and said that the ligaments were twisted. Examination now shows that the muscles of the whole limb are very weak

and much atrophied, those of the shoulder and arm most, of the forearm less and of the hand least (see Fig. 15). Can raise the whole arm forward almost to a right angle. Flexion at the elbow is very weak, of extension much stronger but still much below normal. Rotation of forearm very weak. Movements of wrist and hand fairly strong but much weaker than of left side. The posterior subluxation is marked. The acromion has not the normal inclination from the anterior margin downward and backward but is more horizontal from before backward, indicating that it had sustained pressure from above downward, especially at its anterior portion which is normally the higher and would first receive the pressure from some object above it. At operation, the coracoid process showed distinct evidence of having been bent backward at birth, which may have protected the acromion from the marked bending downward seen in the other cases.

Operation (September 22, 1913).—At the University Hospital, in the service of Professor Edward Martin. Incision along anterior and outer margin of acromion, through the deltoid and exposing the upper end of the humerus. The sharp bending downward of the anterior portion of the acromion discovered in the two preceding operations, was not found, but the more horizontal position was evident. It seemed to be bent downward slightly as a whole. External rotation was stubbornly resisted until the subscapularis tendon and the underlying capsule were divided, when there was a considerable gap between the divided margins. With the arm in external rotation, the humeral head could be pushed forward so far that there was no prominence behind the acromion, but it could not be pushed forward and upward far enough to make a prominence in front of the acromion. It could be seen that this was prevented by the contact of the head against the coracoid process, which seemed to have bent backward considerably at birth. The patient was then turned over and an incision made through the posterior fibres of the deltoid, exposing the tendons of the infraspinatus and teres minor, which were divided near the greater tuberosity with the underlying capsule. The finger in the joint found the glenoid cavity flat from side to side but concave from above downward. With the head pushed as far forward as possible, the margins of the tendons and capsule were overlapped by catgut sutures about $1\frac{1}{2}$ inches. Both wounds closed with a small drain in the posterior

one. A dressing and a plaster case holding the arm in abduction to a right angle and external rotation, were applied. Case opened posteriorly and small drain removed on sixth day. No infection and dressings not removed since.¹⁰

CASE IX.—Girl, nearly five years of age. Very difficult labor. Instruments used. Shoulders very broad. After delivery of face, the severe cyanosis caused the physician to hurry the rest of the delivery by hooking his finger under the right axilla and pulling, when he felt and heard a "crack." Examination afterward excluded a fracture of the humerus which was suspected, but there was a complete paralysis of the whole limb. Dr. J. W. McConnell saw the patient at this time and has followed its course since. He diagnosed an injury of the brachial plexus, but asked me to see the case about two years ago. The power and movement had improved considerably by this time, but the whole limb was still very weak and there was considerable limitation of abduction and external rotation at the shoulder. Not finding a dislocation of the shoulder, I concluded that suitable exercises would restore normal motion and that this would be followed by normal power of the limb. These exercises have been kept up since. I had the second opportunity of examining this child very recently. I expected to find that normal motion had returned, but there was still slight restriction of abduction and external rotation, and this led me to examine the shoulder for an overlooked subluxation which I found together with a bending downward of the anterior portion of the acromion. It was of mild degree but distinct, notwithstanding which the persistent exercises had produced nearly normal motion at the shoulder and power of the whole limb. This case is a striking evidence of the influence of motion on the palsy. In size, shape and nutrition there is no discernible difference between the two limbs. It shows only in the mild restriction in the

¹⁰ The case was removed after six weeks and exercises began to restore motion. Whereas before operation the arm was so weak that the hand could not be brought to the mouth at meals, except by resting the forearm on the table and moving the head toward the hand; twelve days after removal of the case he wrote, "the stiffness is out of the arm so (far that) I can lift it halfway over my head without the assistance of the other. I can take off my hat, blacken my shoes and turn on the electric lights." I believe that this early improvement means, merely, that from the better joint conditions he can make more use of the power he had before operation.

range of movement in the affected limb. The subcutaneous fat is greater than usual for this age, and gives to the affected shoulder almost if not perfectly normal roundness. This is the second case in which I overlooked a mild subluxation on my first examination (see Case VII).

It may be argued that the failure to recognize the subluxation in this and Case VII in my first examinations shows secondary development of the subluxation from an injury to the brachial plexus. I am satisfied that it merely indicates a lack of familiarity with the condition at the time of my first examinations. Both cases were seen only a short time after I saw my first case, in which I recognized the dislocation only after a prolonged examination. I thought it of mild grade but, with the exception of Case VIII, it was the most aggravated of all my cases. The two that were overlooked are about the mildest. I saw Case VII at about 8 months of age, this one (IX) at about three years of age. Fairbank says that at the end of two months the paralysis has so largely recovered that electrical examination is usually unnecessary. Such a paralysis is hardly likely to develop secondarily a subluxation after 8 months or three years. My failure to recognize an existing subluxation in these two cases is easily accounted for by its mild grade, the amount of fat and my inexperience. I had not then developed what I regard as the pathognomonic sign, the absence of the normal prominence of the upper end of the humerus immediately in front of the acromion. This last case is a striking example of what can be accomplished in birth palsy by restoring motion to the shoulder-joint. Reduction of the subluxation is the great indication because perfect motion can occur only in a perfect joint.

THE FREQUENCY AND SIGNIFICANCE OF INJURIES TO THE ACROMION PROCESS.*

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RECENT studies of the etiology and pathological anatomy of certain injuries to the shoulder-joint have done much to make clear the causes of severe symptoms often found when gross lesions of the tissues are not demonstrable by examination. Such facts, however important, should not make us lose sight of that great class of cases in which some lesion to the bony structures of and about the joint may be shown, by X-ray if in no other manner.

The work of Ross and Stewart has called attention to the importance of sprain fractures in the causation of severe symptoms and has made it plain that the extent of a bony lesion by no means determines its immediate symptoms or sequelæ.

In acromial injuries we find a group of conditions often apparently trifling which, nevertheless, are of importance both as to the symptomatology of the lesion itself and because of the significance which a lesion may have in indicating the occurrence of other injuries.

Fracture of the acromion is a very common injury. An examination of the records of the German Hospital for eight years, from 1905 to 1912 inclusive, resulted in finding 89 cases of acromial fracture.

When there is a fracture of the acromion it is one of three classes: (1) A well-marked fracture of a considerable portion of the process; (2) a separation at the epiphyseal line; (3) a sprain fracture.

Of the cases mentioned it was impossible to determine

* Read by invitation before the Philadelphia Academy of Surgery, November 3, 1913.

definitely to which class the fractures belonged, except in those occurring during 1911 and 1912. Of the 40 cases demonstrated by X-ray in 1911 and 1912, 8 were fractures of a considerable portion of the process, 1 was an epiphyseal separation or separation at the epiphyseal line, 25 were sprain fractures, 6 could not be traced.

It is at once evident that fractures including a considerable portion of the process are few compared with the sprain fractures.

It must be apparent also that such fractures present no features as to diagnosis, etc., in any way differing from fractures in general. A typical example is shown in Fig. 1.

The separations at the epiphyseal line are, as far as causation and symptomatology go, merely a subdivision of the fractures of the first class (see Fig. 2).

The sprain fractures furnish the most numerous and in many ways the most interesting subdivision. True sprain fractures, by tearing due to ligamentous pull, are found in three locations: (1) most often at or above the acromio-clavicular junction; (2) at the insertion of the coraco-acromial ligament; (3) the upper surface of the acromion—usually the location of the smallest of the sprain fractures.

These sprain fractures have been noted in the order of frequency of their occurrence. Some of them are quite easily evident on the X-ray plates; others again are most minute. In several instances in which a sprain fracture was noted the diagnosis according to the X-ray plate seemed to me to be doubtful indeed. But a very minute sprain fracture cannot be demonstrated by X-ray, certainly not when only a few hardly perceptible fragments of the bone are pulled loose. It is beyond question that in the majority of instances the diagnosis was based upon substantial grounds.

The fourth variety of sprain fracture or at least fracture of a very small portion of the acromial tip are due very evidently to a force exerted directly either (*a*) by the pressure of the humerus from below, or (*b*) by direct violence to the acromion process.

FIG. 1.



Fracture involving whole acromion process.

FIG. 2.



Injury to epiphyseal line of acromion with sprain fracture of upper surface of acromion.

FIG. 3.



"Chipping" of outer and lower portion of acromion process by force exerted through the humerus.

Some of them in extent and appearance are such that I find them in my records noted as "bruises of the tip of the acromion."

Of the total of 89 cases of fracture of the acromion, 18 were found with other lesions also demonstrable by X-ray. These were 3 instances of associated injury to the clavicle at its acromial end, 3 instances of fracture of the acromion with luxation of the acromial end of the clavicle, 3 instances of old luxation of the humerus, 2 instances of subluxation of the humerus, 1 instance of fracture of the greater tuberosity of the humerus, 1 instance of luxation of the head of the humerus and of the clavicle, 1 instance of luxation of the humerus with fracture of the clavicle, 1 instance of fracture of the head of the humerus with luxation of the clavicle, 1 instance of fracture of the "upper end" of the humerus, 1 instance of comminuted fracture of the surgical neck of the humerus, 1 instance of fracture of the coracoid process and of the head of the radius.

It will be seen at once that these injuries associated with acromial fractures, sprain fractures or otherwise, group themselves into two great classes.

1. Conditions affecting the acromio-clavicular junction.
2. Associated injuries indicating a violent trauma involving the upper end of the humerus and producing either a luxation of the humerus or a fracture.

Since sprain fractures of the acromion are by far more common than any other form of fracture of this part, and since most of the sprain fractures involve the acromion at the acromio-clavicular junction, it is not surprising that at times there should be a similar lesion of the acromial end of the clavicle. And, luxation so-called of the acromio-clavicular articulation, as shown by the X-ray, is but one step further in an acromio-clavicular disjunction. I have never seen such an occurrence in which this separation, accompanying merely a sprain fracture of the acromion, was clinically demonstrable.

Those cases of injury to the acromion in which we have, as in the old or unreduced luxations of the head of the humerus or the fractures of the humerus, evidence of great force ex-

erted upon the upper extremity of the humerus are of great interest because they furnish us probably with an explanation of the severe symptoms often accompanying what seem to be very insignificant acromial injuries.

Before considering these conditions we must take into account the method of causation of acromial injuries.

In all but a few instances in which there is some history of the injury, to be correct, in 8 of the total number of 89, a fall is given as the cause of the acromial lesion. In a considerable proportion of the cases the history stated that a "fall on the shoulder" took place. I believe that these histories are generally incorrect. Codman, who is in this supported by Thomas, has drawn attention to the unreliability of such statements as to shoulder injuries. It is no easy matter to fall in such a way that the first impact is upon the tip of the shoulder.

The only other explanation possible is that, where the acromial injury is not a direct one, it is caused by a force transmitted or applied by the humerus. The possibility of this I have seen mentioned by Dr. G. G. Davis. It is the frequency of this sequence of events that I wish to emphasize. Now since in a fall the arm is practically always thrown away from the body—abducted—we find that the force is applied to the acromion by the greater tuberosity of the humerus, the shaft of the humerus acting as the long end of the lever. It may be possible for a direct upward push on the humerus to do the same thing, the scapula being fixed. One of the series of cases I studied sustained the acromial injury while cranking an automobile and this may be such a case.

The force applied to the acromion may then (*a*) clip its outer end (as Fig. 3), (*b*) "spring" the acromio-clavicular junction, or (*c*) put too much strain upon the coraco-acromial ligament.

In any of these conditions, the acromial fracture or sprain fracture results.

It is evident, therefore, that a minor degree of acromial injury may be the net result in damage to the bony structure of considerable violence.

The association of acromial fracture with luxation of the head of the humerus gives rise to several questions of importance. I was very much interested in Dr. Thomas' explanation and demonstration of acromial injuries associated with the birth palsies of children, which he has found to be the result not of nerve lesions but of injury to the bony and ligamentous structures of the shoulder.

The fact that we occasionally find injuries to the acromion with luxations at the shoulder leads us to consider two possibilities: (1) That many cases of acromial injury are associated with luxations of the shoulder which become spontaneously reduced; (2) that the giving way of the acromion or of the structures attached to it accompanies trauma not quite sufficient to cause complete luxation, yet sufficient to injure the capsule of the joint and thus produce subsequent symptoms.

The spontaneous reduction of a shoulder luxation is beyond a doubt possible but in the majority of instances of acromial injury the examination fails to reveal evidences that actual luxation has occurred. We are thus thrown back upon the second possibility. It seems to me most likely that the application of a force in abducting the shoulder sufficient to produce a fracture of the acromion must be such as to produce an accompanying injury to the contiguous soft parts.

The symptomatology of acromial injuries, even of the sprain fractures apparently most insignificant, bears us out in this view.

A certain proportion of these cases show immediately after injury only the two symptoms referable directly to the acromial condition, *i.e.*, localized tenderness over the acromion at the seat of injury and pain on abduction. After the lapse of three or four weeks these cases recover, occasionally, however, requiring active massage and passive motion for an equal length of time before recovering full function. Most cases of such injury, however, run a more severe and protracted course. Tenderness over the acromion is persistent and pain here and throughout the shoulder is complained of. Abduction is limited and in at least two cases that have come to my notice but which

I was not able to examine, an apparently permanent disability of the shoulder resulted.

It must be evident that while a fracture or sprain fracture of the acromion should and does cause localized tenderness and pain, and pain upon abduction, these symptoms should cease with proper treatment, at a time when bony or fibrous union has taken place. The persistence of symptoms points to the existence of a concomitant shoulder condition. There has been much said concerning subacromial bursitis as causing stiff and painful shoulders. I have never seen any case in which I could make this diagnosis.

We must then consider the accompanying lesion as being, as has before been stated, a luxation of the head of the humerus, spontaneously reduced, or an injury just short of producing luxation but with similar injury to the joint capsule.

In the clinic at the German Hospital we have been fortunate in avoiding bad end results in cases showing fracture of the acromion, because we treat every case, however slight, of injury to the acromion by rest for three weeks, with early massage and later, if necessary, by vigorous active and passive motion.

In conclusion, then, I believe we may safely state:

1. That injuries to the acromion process are not infrequent.
2. That they are important not only because the injuries themselves cause more or less pain and discomfort, but especially because practically all acromial injuries are caused by indirect force applied by the humerus acting as a lever and therefore an injury of this kind to the acromion is evidence that there has been either luxation spontaneously reduced or, as is more often the case, a lesion nearly approaching luxation with a corresponding injury to the joint structures.

I am indebted to Drs. G. G. Ross and A. D. Whiting, my chiefs in the German Hospital Out-Patient Department, for permission to report these cases and to Dr. A. G. Miller, the radiographer of that institution, for his kindness in furnishing the plates I have brought and his many demonstrations on this subject to me, and to the Fellows of the Academy for the opportunity to present this paper.

STENOSIS OF THE PYLORUS IN INFANCY.

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THE subject of this paper will be considered in four divisions: First, a systematic statement of the facts of the disease; second, reasons why the treatment should be surgical; third, a consideration of two problems which have arisen in connection with the study of these cases; and fourth, a report of my own experience with this disease.

I. A SYSTEMATIC STATEMENT OF THE FACTS OF THE DISEASE.

The Pathology.—A pyloric tumor is always present. It is about the size of the terminal phalanx of a finger or thumb, oval in shape, smooth of surface, firm or hard, like cartilage. There are never adhesions about it. The lumen of the pylorus is narrowed. The longitudinal folds of mucous membrane are enormously hypertrophied, adding to the narrowness of the lumen. This tumor is caused by an overgrowth and an hypertrophy of the circular muscle fibres of the pylorus. The tumor is a muscle tumor; it represents an overgrowth of muscle tissue.

The tumor is as evident at autopsy as upon the living. It exists in the living, whether gastric peristalsis is present or not. It is no more evident to direct touch when gastric peristalsis is present than when there is no gastric peristalsis. It is a passive tumor. Muscle contraction is not necessary to its existence.

That the pyloric tumor encroaches upon the lumen of the pyloric canal is proven not only by the clinical signs in these cases but by direct examination of the stomach at autopsy and at the operating table. The tumor itself is sufficient cause for the obstruction to the pyloric canal. The obstruction is an an-

atomic one, and is not necessarily dependent upon physiologic causes. The significance of this fact will appear later.

All other pathologic changes are secondary to the obstruction caused by the tumor, viz., the thickened or stretched gastric wall, the dilated œsophagus, the empty intestine, the emaciated and wizened body of the baby.

The Etiology.—What is the cause of this tumor found at the pylorus in these new-born babies? This has been the subject of much speculation. The most likely hypothesis is, I think, the one that considers it a congenital anomaly. The tumor represents a congenital overgrowth of muscle tissue. In support of this view are the following considerations:

1. The earliest indications of the presence of a pylorus is in the third month of fetal life. There is, therefore, ample time for the growth of muscle tissue to take place.

2. There is one case recorded in literature by Dent of a pyloric tumor in a seven months old fœtus. The tumor shows the same structure that is found in the stenosis cases examined after birth.

3. The symptoms in these cases appear so near to birth that it is impossible to conceive of the overgrowth of muscle as having taken place between birth and the onset of symptoms. My youngest case was only 14 days old.¹ The tumor in this case was fully developed and as definite as those seen in cases 3 months old.

4. The tumor is associated occasionally with other congenital defects, such as imperforate anus and club foot.

5. Aberrant Brunner's glands that normally belong only in the duodenum have been found in the tumor at the pylorus. It seems to me therefore that the evidence at hand favors a prenatal or congenital overgrowth of muscle tissue as the best explanation for the tumor present in these cases of infantile pyloric stenosis.

Why talk of or consider the etiology? Because it is important to determine the significance of spasm of the pylorus

¹ Boston Med. and Surg. Jour., December 14, 1905.

which is said to occur in certain of these cases. If it is likely that a congenital overgrowth of muscle is the cause of the tumor, then spasm, which has never yet been known to have caused a hyperplasia, is removed still further from the field of symptomatology in these cases. I think it will appear as the facts concerning this disease are unfolded that spasm has but little to do with these cases of tumor obstruction.

The Symptoms.—The symptoms are those of obstruction. The patient is usually a healthy appearing breast fed boy. There is at first, often overlooked, loss of appetite. The baby does not care to nurse. Vomiting appears soon after birth or within the first two or three weeks. This vomiting is characterized by its persistence and its projectile character. It is the vomiting of obstruction. The quality of the food seems to make no difference with the vomiting, the vomiting depending rather upon the quantity taken. The amount of the vomitus depends largely upon the amount of the feeding. The material vomited is the food taken. The vomitus never contains bile, an excess of HCl, blood, mucus, or lactic acid. Because of the little material passing through the pylorus into the duodenum the baby is constipated. The dejections are consequently small in amount; there being very little milk residue the stool, consisting almost entirely of bile, pancreatic juice, and cast-off epithelium, is meconium-like.

There is a progressive loss of weight. The child has not been receiving sufficient nourishment to keep the weight up to the normal gain. Instead of the normal gain there is an actual loss. There may be erratic gains in weight which subsequently are lost. If the baby's abdomen is uncovered while the baby is feeding, or while the baby is taking water from the bottle, there will be noticed rather vigorous peristaltic waves passing across the upper half of the abdomen from left to right. This visible peristalsis is very marked in many cases. The stomach is contracting violently in the attempt to overcome the obstruction. If the abdomen is palpated from the side and from before backward, in about from 60 to 80 per cent. of the cases it will be possible to feel the tumor between the thumb and

finger. This will be noticed more readily just after the peristaltic wave passes the pyloric portion of the stomach. The tumor may be obscured by an enlarged liver and mistaken for enlarged lymphatic glands, or even for the lower pole of the right kidney. The stomach itself will be dilated, particularly if the baby has lived some time after the obstructive symptoms have been present.

The obstructive vomiting, the palpable tumor, the visible peristalsis, the meconium-like stool, the epigastric fulness, the continual loss of weight, these are the symptoms of pyloric obstruction in infancy. Despite experiments with feeding and the use of drugs of various sorts, the baby gradually wastes away and dies of starvation. The baby dies of pyloric obstruction.

This is the typical picture of an unrelieved pyloric stenosis in infancy, and it is the usual termination. The death certificates in cases of this kind in the past, and also to-day, are often signed by the attending physician, inanition, acute gastritis, infantile atrophy, gastro-intestinal catarrh, marasmus, dyspepsia or pyloric spasm.

Diagnosis.—The diagnosis in typical cases is comparatively easy. However, there are many cases of babies difficult to feed who may be suspected of having a pyloric tumor. Pediatricians have employed the term "spasm of the pylorus" in order to explain the obstructive symptoms seen in little babies who suffer from persistent vomiting, and in whom there is no demonstrable tumor. This idea of a spasm of the pylorus is a purely hypothetical notion introduced by clinicians to account for symptoms which they are otherwise unable to explain. There is little doubt that there is a group of cases difficult to feed which is fairly easily explained by the idea of pyloric spasm without the tumor. These supposedly pure spasm cases occur in bottle-fed, excitable, irritable, neurotic babies. The onset of symptoms is several weeks after birth. The stools contain fecal material. A pyloric tumor, if felt, is felt only when the gastric contraction occurs. The vomiting lacks the characteristics of the tumor cases. Cases of obstruction from pyloric spasm sometimes die from starvation.

The serious and desperate cases are the ones that may become confused with the true tumor cases. These desperate spasm cases may occasionally but very rarely require surgical treatment.

The employment of the X-ray for diagnosis in these doubtful cases is likely to prove of a good deal of assistance. The behavior of the stomach in a normal baby after the milk of bismuth has been introduced into it is definitely known. The behavior of the stomach in a case of pyloric obstruction due to tumor when the milk of bismuth is introduced is likewise known. If bismuth is introduced into the stomach of a baby having a supposed pyloric spasm, the behavior will be often different from the record in either of the other two conditions. This difference may be helpful in the differentiation of these conditions. Every suspicious case of pyloric obstruction in which there is doubt as to whether there is a tumor or not should be X-rayed. The subnitrate of bismuth may be administered by mouth and the stools watched for the appearance of bismuth crystals (Talbot). The appearance of these crystals in the stools will be indicative of something passing through the pylorus. If the stools are infrequent and small in amount, these facts in themselves may be significant.

The Prognosis.—The mortality of this disease is high. Most cases of congenital pyloric stenosis die of starvation. The question is how long will it take a small baby to starve to death while the family physician experiments with drugs and foods, which under the conditions are absolutely of no use. It will take about three months, and this is the usual length of life of these small babies. Of course, the degree of obstruction in these cases, as has already been pointed out, varies. A baby with considerable obstruction will live a shorter time than a baby who has less obstruction, other things being equal.

There are cases being reported each year of young adults who have suffered during infancy and childhood from partial pyloric obstruction. Such individuals reaching maturity after years of gastro-intestinal invalidism, poorly nourished, and probably under-developed,—such individuals are more fre-

quently than formerly being recognized as instances who as babies have had a partial pyloric obstruction and have survived despite the obstruction. Hezekiah Beardsley,² in 1788, reported the case of a child who had lived five years with a pyloric tumor, which was determined at the autopsy. Habersohn,³ Lebert,⁴ Landerer,⁵ Rudolph Maier,⁶ Dunne,⁷ Tilger,⁸ and Barling,⁹ all have reported cases of this sort.

II. TREATMENT.

I believe that the treatment of stenosis of the pylorus in infancy should be surgical as soon as the diagnosis is made, and for the following reasons:

That the pure pyloric spasm obstruction can be cured by medical treatment in a large proportion of cases is true. It is also true, so far as I am able to learn, that there is no case of true tumor which has yet been cured by medical treatment. So far as I am able to determine, no so-called medically "cured" case has even been proven to have had the disease, but on the other hand many cases of supposed "cure" have relapsed and have been subsequently treated surgically. The tumor has been demonstrated to exist and a cure by surgical means has followed. Those who advocate and practise the medical treatment of true tumor cases do so upon the erroneous hypothesis that muscle spasm is the chief cause of the obstruction. They lose sight of the fact that it is the tumor that obstructs. At best, medical treatment relieves only hypothetical spasm that perhaps accompanies certain tumor cases. Medical treatment does not effectively remove the primary cause of the obstruction.

The improvement in Heubner's series of cases and in the

² Beardsley Hezekiah: *Trans. New Haven Co. Med. Soc.*, 1788.

³ Habersohn: *Diseases of the Abdomen*, 1862.

⁴ Lebert: *Diss.*, Tübingen, 1878.

⁵ Landerer: *Diss.*, Tübingen, 1879.

⁶ Maier, Rudolph: *Virchow's Arch.*, Bd. cii, s. 413, 1885.

⁷ Dunne: *Jahresbericht d. Jenner'schen Kinder-Hospitals*, Bd. xix, 1881.

⁸ *Virchow's Arch.*, Bd. cxxxii, s. 290, 1893.

⁹ Barling: *The London Lancet*, January 29, 1913, 1913.

cases of others who have thought that they have been treating tumor cases with success is to be accounted for upon the basis of mistaken diagnosis, or a temporary and not a permanent cure.

It was about 23 years ago that the pyloric tumor cases were first well described. During all these 23 years the physician has painstakingly striven to treat such cases by medicines and by carefully prescribed feeding. The estimated mortality from an expectant medical treatment is between 80 and 90 per cent. (Monier). It is upon this carefully studied medically-treated post-mortem material that much of our present pathologic knowledge of this disease is based. The medical treatment of the tumor cases has signally failed to effect a cure.

What has surgery already accomplished in the care of these cases? Surgery has gradually lowered the mortality in the treatment of these cases. The mortality, once high, very distinctly is decreasing. The first time surgeons attempted to treat this disease was in 1898. From 1898 to 1905 is a period of seven years. During this period gastric surgery was developing. Operative technic was unsettled. The choice of procedure adapted to certain conditions was undetermined. This was an experimental period for gastric surgery in the adult and absolutely a new field in infants. Several different operations were done by many operators for the same condition. The cases operated upon had gone almost the limit of life under medical experimentation. Is it any wonder that the mortality from surgical operation during this period upon such material was very considerable? The mortality for this period was 46.5 per cent. No apology is needed here for this mortality, for more than half the babies entrusted to the surgeon were saved by operation. Even this was a great improvement over the medical mortality.

Consider now the next 7 years, the period from 1905 to 1912. The lowering of the mortality under surgical treatment has been remarkable. I have not yet collected all operated cases during this period. I have three groups, however, which are fairly representative of the period.

1. The group of ten operated cases from the Pacific Coast, collected by Stillman. In this group six different surgeons operated. A posterior gastro-enterostomy was done in each case. Of the ten cases only one died.

2. The group operated upon by Richter, of Chicago. There were 9 cases, only one died.

3. My own group of 17 cases with 3 deaths, a mortality of 17.6 per cent. A total, therefore, of 36 cases with 5 deaths, or a mortality of 13.8 per cent.

The mortality of posterior gastro-enterostomy in congenital stenosis of the pylorus is low under the above conditions.

III. CONSIDERATION OF TWO PROBLEMS.

There are two important problems which this group of cases helps to solve.

(a) What is the effect of gastro-enterostomy upon the metabolism of the body? There are those who think that a gastro-enterostomy impairs digestion. The passage of the food through the artificial stoma is looked upon as a real harm to the individual. Digestion, they say, cannot proceed in the proper fashion and the individual will suffer because of such impairment of digestion.

In order to determine the effect of gastro-enterostomy upon digestion it occurred to me that these babies with congenital stenosis might serve for metabolism investigations. The work done by Dr. Talbot, of Boston, upon a series of babies who had had a posterior gastro-enterostomy done for a stenosis of the pylorus has demonstrated that in these cases there is no impairment of the digestion of fat, starch and protein. The details of these experiments together with the results, I have already reported with Dr. Talbot in a former paper.¹⁰ If to the chemical evidence thus obtained be added the clinical fact that all these babies, without exception, are apparently thriving and in perfect health, have lived several years following the operation and gained in weight and height, the evidence is overwhelming that in these human babies gastro-enterostomy

¹⁰ Surg., Gynec. and Obstet., September, 1910, pp. 275-287.

has no deleterious effect upon the metabolism as measured by the digestion of fat, protein and starch and the normal development.

These experiments serve to confirm the work of Cameron and Paterson and make it absolutely conclusive that in the otherwise normal individual a posterior gastro-enterostomy has no harmful effect upon digestion, so that the opposition to this operation cannot be based upon any such conception as stated above.

(b) The second question that arises in connection with these cases is what becomes of the muscle tumor at the pylorus; does it disappear as the child grows older? I think from the evidence at hand that it probably persists and does not disappear, and for the following reasons:

(1) Through the assistance of Dr. W. J. Dodd, of Boston, skiagrapher at the Massachusetts General Hospital, and instructor in Roentgenology in the Harvard Medical School, I have been able to obtain further X-rays upon this series of stenosis of the pylorus cases operated upon by me, and these X-rays show uniform findings. In every case, no matter how many years following operation, the bismuth meal is seen to pass through the stoma, and in only a very few is it seen to pass in slight amount through the pylorus. In other words, the obstruction at the pylorus, which has been proved in each of these cases to have existed, is demonstrated by the X-ray to still exist. The tumor is still present and still obstructs.

(2) It has been demonstrated by certain physiologists that if the pylorus remains open and is unobstructed the stomach contents will be forced through the pylorus even though an artificial stoma be present. 'On the other hand, it has been demonstrated that if the pylorus has been closed by some form of obstruction either partially or completely, the food will be forced through the artificial stoma in whole or in part. In these cases the food is seen to be going through the stoma and it is reasonable to suppose, therefore, that the obstruction still persists. In other words, the physiological evidence confirms the evidence from the X-ray.

(3) Bearing upon the persistence of the pyloric tumor after operation mention must be made here of the pathological evidence in the unique case of Morse-Murphy-Wolbach.¹¹ The facts are these: A boy baby with pyloric stenosis diagnosed by Dr. J. L. Morse, was operated upon by Dr. F. T. Murphy by a posterior gastro-enterostomy. The pyloric tumor was seen and palpated. The child lived $7\frac{1}{2}$ months, weighing then 19 pounds. During this time the baby had developed as a normal child, was breast fed, had not vomited, and had had normal movements. When 8 months old the baby died of nothing connected with the operation. Fortunately a complete autopsy by Dr. Wolbach was secured. The artificial stoma was found patent and functionally efficient. The pyloric tumor—and this is the point of present especial interest—persisted and appeared as at the time of operation. Microscopical study found the tumor to be a true tumor of circular muscle fibre, hypertrophy. This is the only instance of congenital pyloric stenosis that has been studied so long as $6\frac{1}{2}$ months following a successful gastro-enterostomy.

(4) Attention should be called to the increasing group of adult cases of partial obstruction reported by Beardsley, Landerer and Barling, and others, who have had symptoms of pyloric obstruction for many years and have reached young adult life with all the evidences of difficult feeding and impaired nutrition. These are cases with a pyloric tumor which has partially obstructed the lumen of the pylorus, not sufficiently to have caused death from starvation, but only sufficiently to have caused impaired digestion and malnutrition.

This evidence, then, from the X-ray, from physiology, from the post-mortem table, and from clinical observation, points pretty conclusively to the fact that the muscle tumor at the pylorus does not materially change. This is not a mere academic question, but it has, of course, a practical bearing, and places the surgical treatment of this condition upon a very firm basis.

¹¹ Boston Med. and Surg. Jour., 1908, clviii, p. 480.

IV. REPORT OF CASES.

I wish to report here in detail the 17 cases treated by me surgically and to call attention to the fact that whereas the first 12 cases were operated upon without a death, there have been three deaths in the last 4 cases, the deaths being dependent upon the starved condition of the baby at the time of operation. This experience only serves to emphasize the importance of as early a diagnosis as possible in order that the surgical operative measures may be undertaken with the very greatest chance of the baby's recovery.

I operated during the past 8 years upon two babies who were thought to have a pyloric tumor and it was found at operation that they had no tumor. One case recovered from the exploration and is well to-day. One case died of some strange skin eruption unconnected with the operation. I have never operated upon a case of supposed pyloric spasm.

All the X-rays were taken by Dr. Walter Dodd of Boston, Mass.

CASE I.—Wales.¹² A patient of Dr. C. W. Townsend, of Boston, and Dr. West, of Newton Center, Mass. The operation was done by Dr. C. L. Scudder. A boy baby. Weighed at birth 10 pounds, 11 ounces. He was artificially fed and vomited shortly after birth. The vomitus was the milk taken at a feeding. The vomitus contained no bile. The vomiting was expulsive in character and occurred immediately after each feeding. He lost two pounds in weight before the operation. At operation tumor was seen and palpated at the pylorus. A posterior gastro-enterostomy was done when he was 14 days old. This is the youngest recorded recovery after gastro-enterostomy for congenital pyloric stenosis. He weighed 33 pounds plus when he was 3 years and 2 months old. His diet was that of a healthy child for this age. He has always been inclined to constipation. See Fig. 2 (1910).

Weight May 18, 1910, 44 pounds.

He is now eight years old and has had no trouble with digestion. He has always been perfectly well excepting that he is a slightly nervous child.

CASE II.—Larrabee.¹³ A patient of Dr. Ilsley, of Medford,

¹² First reported in the Boston Med. and Surg. Jour., December 14, 1905.

¹³ First reported in the Boston Med. and Surg. Jour., February 22, 1906

Mass. The operation was done by Dr. C. L. Scudder. A boy baby. He was breast fed. His weight at birth was $6\frac{3}{4}$ pounds. He vomited soon after birth and constantly until the operation on the 24th day. The vomiting occurred usually after several feedings and came in spurts. Gastric peristalsis was observed after each feeding. No tumor was felt. The child lost in weight and strength. At operation a tumor was seen and palpated at the pylorus. The operation was a posterior gastro-enterostomy. When he was three years and eight months old his general diet was milk, eggs, broths, never meat excepting chicken occasionally; bread, crackers, potatoes, Ralston food, cereals, peanut butter, butter, celery, turnips, fruit.

Weight, May 24, 1910, $37\frac{1}{4}$ pounds, when three years and eight months old. See Figs. 3, 4, 5, 6 (1910).

In February, 1913, a bismuth X-ray was taken of the child's stomach and he was apparently perfectly well. Bismuth leaves by the stoma. He is now eight years old. See Fig. 7 (1913).

CASE III.—Colby.¹⁴ Patient of Dr. J. L. Morse, of Boston, and Dr. Day, of Newburyport. The operation was done by Dr. C. L. Scudder. A boy baby. He began to vomit when he was 16 days old and the vomiting was constant until the operation on the twenty-second day. The material vomited was the milk taken. The vomitus contained no bile. The baby was breast fed. He had lost in weight. Gastric peristalsis was observed. A pyloric tumor was felt. At operation the tumor was seen and palpated at the pylorus. The operation was a posterior gastro-enterostomy. The child's bowels are never constipated.

When he was two years and five months old his diet consisted of milk, soft boiled eggs, steak, lamb, and broths, butter, bread, cereal, potatoes, macaroni, puddings and fruit. See Figs. 8, 9, 10 (1910).

In February, 1913, a bismuth X-ray was taken of the child's stomach, and he was apparently in perfect health. The bismuth leaves the stomach by the stoma. He is now seven years old. See Fig. 11 (1913).

CASE IV.—Stevens.¹⁵ A patient of Dr. Charles Putnam, of Boston. The operation was done by Dr. C. L. Scudder. A boy baby. The child was breast fed and artificially fed. He began to vomit when he was 14 days old. The material vomited was the milk taken. The vomitus contained no bile. Gastric peristalsis

¹⁴ Reported in the Boston Med. and Surg. Jour., August 6, 1908.

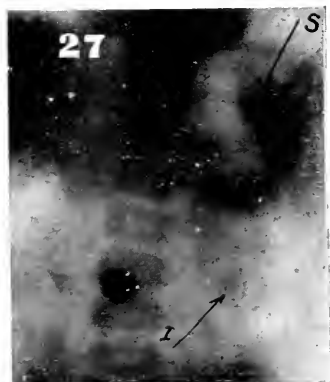
¹⁵ Reported in the Boston Med. and Surg. Jour., August 6, 1908.

FIG. 1.



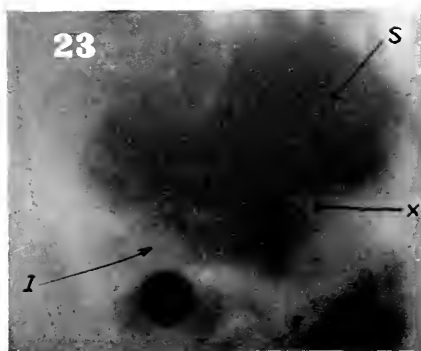
Normal adult stomach. X-ray after bismuth meal. Note that the duodenal cap and pyloric part of the stomach are to the right of the spine. X-ray by Dodd.

FIG. 2.



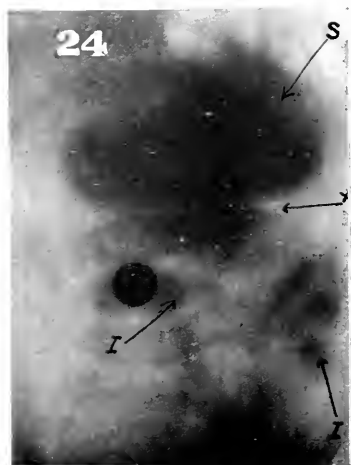
Wales. Case I. X-ray of stomach containing bismuth food 5 years following a posterior gastro-enterostomy. Note that the shadow of the bismuth is to the left of the median line. Bismuth is seen in the intestine. S, stomach; I intestine. 1910.

FIG. 3.



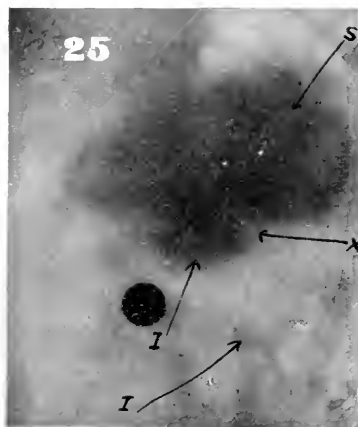
Larrabee. Case II. X-ray of stomach containing bismuth food 4 $\frac{3}{4}$ years following a posterior gastro-enterostomy. Note similar findings as those in the previous figure. S, stomach; I, intestine; X, stoma. 1910.

FIG. 4.



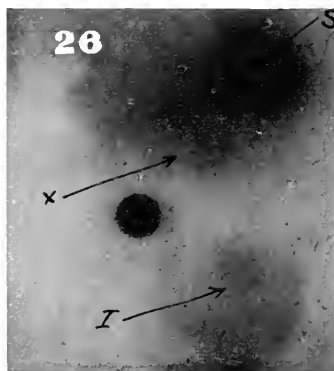
Larrabee. Case II. X-ray of stomach containing bismuth food 4 $\frac{3}{4}$ years following a posterior gastro-enterostomy. Note the definite stoma location and food seen coming through it. No shadow of food in the duodenum next to the pylorus. S, stomach; I, intestine; X, stoma. 1910.

FIG. 5



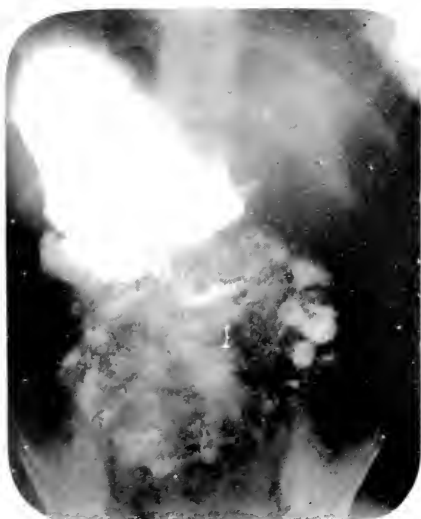
Larrabee, Case II. X-ray of stomach containing bismuth food $4\frac{1}{2}$ years following a posterior gastro-enterostomy. Note the bismuth leaving the stoma at "X" the bismuth food in the intestine at "y." S, stomach; I, intestine. 1910.

FIG. 6.



Larrabee, Case II. X-ray of stomach containing bismuth food $4\frac{1}{2}$ years following a posterior gastro-enterostomy. Note the bismuth has left the stomach; as faintly shown at "X" is the stoma. S, stomach; I, intestine. 1910.

FIG. 7



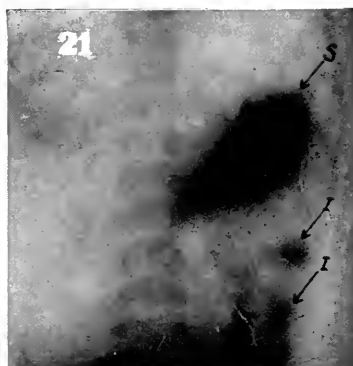
Larrabee, Case II. X-ray of stomach containing bismuth food eight years following a posterior gastro-enterostomy. 1913. No food seen going through pylorus. St, stomach; S, stoma; I, intestine.

FIG. 8.



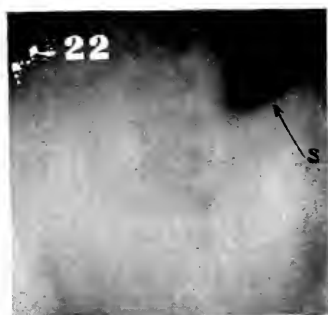
Colby, Case III. X-ray of stomach containing bismuth food $3\frac{1}{2}$ years following a posterior gastro-enterostomy. Note a later X-ray with more food in intestine and no shadow of food leaving the pylorus. S, stomach.

FIG. 9.



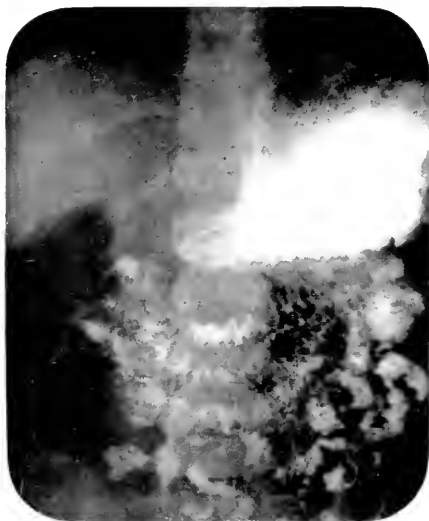
Colby. Case III. X-ray of stomach containing bismuth food $3\frac{1}{2}$ years following a posterior gastro-enterostomy. Note shadow of food in intestine and no shadow of food passing duodenum. S, stomach; I, intestine.

FIG. 10.



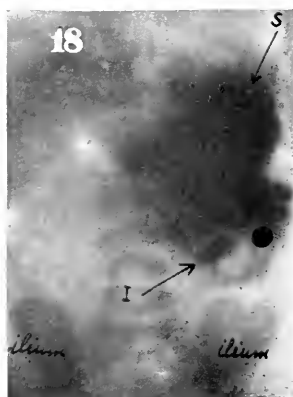
Colby. Case III. X-ray of stomach containing bismuth food $3\frac{1}{2}$ years following a posterior gastro-enterostomy. Note shadow wholly to the left of the median line. S, stomach.

FIG. 11.



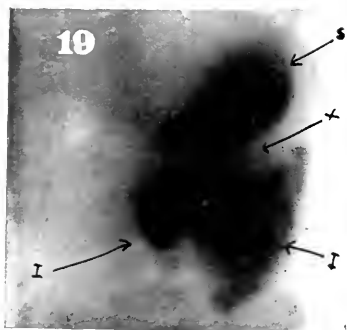
Colby. Case III. X-ray of stomach containing bismuth food seven years following a posterior gastro-enterostomy. 1913. Food not seen leaving pylorus.

FIG. 12.



Stevens. Case IV. X-ray of stomach containing bismuth food $2\frac{1}{2}$ years following a posterior gastro-enterostomy. Note shadows are all practically to the left of the median line. S, stomach; I, intestine. 1910.

FIG. 13.



Stevens. Case IV. X-ray of stomach containing bismuth food 2½ years following a posterior gastro-enterostomy. Note food shadow at stoma "X" and in intestine below. S, stomach; I, intestine. 1910.

FIG. 14.



Stevens. Case IV. X-ray of stomach containing bismuth food five years following a posterior gastro-enterostomy. 1913. Note stoma at S.

FIG. 15.



Nutting. Case V. X-ray of stomach containing bismuth food 1½ years following a posterior gastro-enterostomy. Note no shadow at pylorus and duodenum, suggestion of stoma at "X."

FIG. 16.



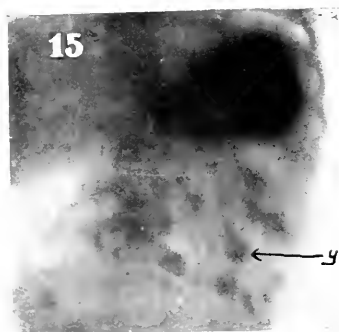
Nutting. Case V. X-ray of stomach containing bismuth food five years following a posterior gastro-enterostomy. 1913. Note food with bismuth leaving stomach at stoma S.

FIG. 17.



Matthews. Case VI. X-ray of stomach containing bismuth food, $1\frac{1}{3}$ years following a posterior gastro-enterostomy. Note shadow of food in stomach and intestine. Some shadow across median line to right side. 1910.

FIG. 18.



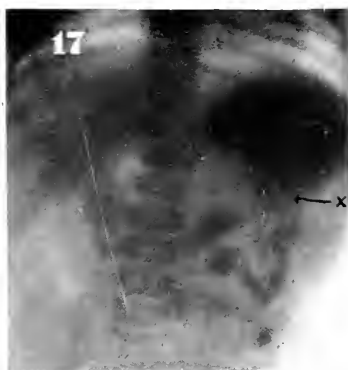
Matthews. Case VI. X-ray of stomach containing bismuth food $1\frac{1}{3}$ years following a posterior gastro-enterostomy. Note shadow limited to left side and intestine. 1910.

FIG. 20.



Hills. Case X. X-ray of stomach containing bismuth food three years following a posterior gastro-enterostomy. 1913. Food leaving stomach at stoma.

FIG. 19.



Matthews. Case VI. X-ray of stomach containing bismuth food, $1\frac{1}{3}$ years following a posterior gastro-enterostomy. Note shadow of food in intestine and stomach, none passing pylorus. Suggestion of stoma at "X." 1910.

F.G. 21.



Case XI. Note the stomach bulging the abdominal wall just under the left costal border, as it is contracting vigorously in attempting to overcome the obstruction at the pylorus, visible peristalsis. (Wilson.)

FIG. 22



Case XI. Note that the visible peristaltic, gastric wave is more evident than in Fig. 21 as the wave passes further on the stomach toward the left. (Wilson.)

FIG. 23.



Case XI. X-ray taken after the operation showing the bismuth leaving the stomach through the new stoma. (Wilson.)

FIG. 24.



Case XII. An X-ray taken previous to operative treatment. Note the bismuth shadowy outline of the stomach and note that the bismuth remains largely in the stomach. The X-ray was taken some time after the injection of the bismuth. (Dunham.)

FIG 25.



Case XII. X-ray taken after the operation. The bismuth is seen generally in the left side and middle of the abdomen after it has passed the gastro-intestinal stoma. (Dunham.)

FIG. 26.



Case XII. X-ray taken a little later than Fig. 25. Note the larger amount of bismuth in intestine and the indicated situation of the stoma (indicated by the arrow). (Dunham.)

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was evident. No pyloric tumor was felt. The operation was done when he was 25 days old. At operation tumor was seen and palpated at pylorus. The operation was a posterior gastro-enterostomy. At 10 months old the child weighed $20\frac{1}{4}$ pounds. When he was two years and 4 months old he weighed $31\frac{1}{2}$ pounds. He was in perfect health. He is inclined to be constipated, and laxatives have to be used a good deal. See Figs. 12, 13 (1910).

In February, 1913, a bismuth X-ray was taken of the child's stomach, and he was apparently perfectly well. The bismuth leaves stomach by the stoma. He is now five years old. See Fig. 14 (1913).

CASE V.—Nutting.¹⁶ A patient of Dr. Cook, of Fitchburg, Mass., and Dr. John L. Morse, of Boston. The operation was done by Dr. C. L. Scudder. A boy baby. He began to vomit at 4 weeks and 5 days old. He weighed at that age $8\frac{1}{2}$ pounds. The movements were normal in color. The character of the vomiting was explosive. The vomitus consisted of the milk taken at a feeding. The vomitus contained no bile. There was very marked gastric peristalsis felt through the abdominal wall. A pyloric tumor was indistinctly felt in the region of the pylorus. At operation a tumor was seen and palpated at the pylorus. A posterior gastro-enterostomy was done when the child was 7 weeks and 5 days old. His weight at the time of the operation was 6 pounds and four ounces. At the end of three months after the operation he weighed $11\frac{1}{2}$ pounds. He seemed to be in perfect health.

The food given immediately after the operation was breast milk and a home modification. The food, May, 1910, consisted of a mixture of top milk, cream, peptogenic milk powder, lime water, and boiled water, 4 ounces, given every 2 hours, approximately.

Weight, May 29, 1910, 27 pounds. See Fig. 15 (1910).

In May, 1913, a bismuth X-ray was taken of the child's stomach and he was apparently perfectly well. The bismuth left the stomach by the stoma. He was four years and nine months old, and weighed 42 pounds. See Fig. 16 (1913).

CASE VI.—Matthews.¹⁷ A patient of Dr. Elam, of Gardner, Mass., and Dr. John L. Morse, of Boston. The operation was done by Dr. C. L. Scudder. A boy baby. He weighed 6 pounds

¹⁶ Reported in the Boston Med. and Surg. Jour., March 4, 1909.

¹⁷ Reported in the Boston Med. and Surg. Jour., Sept. 15, 1910.

at birth. He was breast fed and seemed in good health for the first 3 weeks. He increased in weight to 7 pounds and 12 ounces. When he was 3 weeks old he began to vomit about an hour after each feeding. The material vomited was the milk taken at a feeding. The vomitus contained no bile. The character of the vomiting became explosive. There was a loss in weight of one-half pound in the ten days previous to the operation. A pyloric tumor was easily palpable. There was marked gastric peristalsis. At operation a tumor was seen and palpated at the pylorus. A posterior gastro-enterostomy was done when the child was five weeks old.

Weight, May 18, 1910, 21 pounds. The food taken was breast milk. See Figs. 17, 18, 19 (1910).

In May, 1913, the child's mother reported that he was perfectly well excepting that he is subject to colds.

CASE VII.—D. H., Jr.¹⁸ A patient of Drs. Morse, Swain, and Dunn, of Boston. The operation was done by Dr. C. L. Scudder. A boy baby. His weight at birth was 9 pounds. He began to vomit when he was six weeks old. At that time he weighed 10 pounds and 11 oz. Breast feeding was discontinued immediately and artificial feeding begun. At the time of the operation he weighed 8 pounds and 11 oz. The vomitus contained specks of bile. The amount vomited was the whole of a feeding. The stools were meconium-like. Gastric peristalsis was visible. A characteristic tumor was palpable. At operation a tumor was seen and palpated at the pylorus. A posterior gastro-enterostomy was done at 7 weeks and 4 days of age. The child was in perfect health when he was 10 months and 24 days old, and weighed 20¼ pounds, May 18, 1910.

In May, 1913, the mother reported that the child was perfectly well as far as his digestion was concerned.

CASE VIII.—W. F. H., Jr.¹⁹ A patient of Dr. Straw, of Manchester, N. H., and of Dr. John L. Morse, of Boston. The operation was done by Dr. C. L. Scudder, April 22, 1910. A boy baby. He weighed 7½ pounds at birth. The baby was breast fed. He began to vomit when he was 16 days old. For the next two weeks he was fed a mixture of whey and modified milk, with a rectal feeding of peptonized milk every 2 hours. He had occasional cyanotic attacks. He had dilatation of the stomach, collapsed bowel and meconium-like movements. He had lost much flesh. His

¹⁸ Reported in Surg., Gynec. and Obstetrics, Sept., 1910, pp. 275-287.

¹⁹ Reported in Surg., Gynec. and Obstetrics, Sept., 1910, pp. 275-287.

general condition was poor. At operation a tumor was seen and palpated at the pylorus. The operation was done when he was 4 weeks and 4 days old. The operation was a posterior gastro-enterostomy.

This boy, Oct., 1913, 3 years after operation, is well and strong and developing normally.

CASE IX.—Gove. A patient of Dr. Charles A. Sturtevant, of Manchester, N. H., and Dr. John L. Morse, of Boston. The operation was done by Dr. C. L. Scudder, June 13, 1910. A boy baby. He weighed at birth $9\frac{1}{2}$ pounds. He was breast fed for five weeks and gained two pounds, but had colic all the time. Various formulas for feedings were then tried with indifferent success. He sometimes went several days without vomiting and then vomited several feedings at a time. The vomiting was occasionally explosive. He just held his weight. There was marked visible peristalsis. A mass about the size of a lead pencil could be felt just below the right border of the ribs nearly reaching the anterior axillary line. At operation a tumor was seen and palpated at the pylorus. A posterior gastro-enterostomy was done when the child was five months old. He is now, October, 1913, in perfect health, and is two years old.

CASE X.—Hills. A patient of Dr. MacLean, of Somerville, and of Dr. John L. Morse, of Boston. The operation was done by Dr. C. L. Scudder, September 11, 1910. A boy baby. He weighed four pounds at birth. The baby was breast fed. He began to vomit when he was thirty-five days old. Up to this time he had been well.

Certain things are interesting in connection with this case. First, the baby's vomiting began on or about the day that the mother's catamenial period was re-established. It was, therefore, a question whether it being a breast fed baby the mother's milk was altered in any way to cause the vomiting. Second, a definite tumor was felt in this case and the tumor was large and on the right side below the umbilicus. The tumor was low and felt so large that it was a question whether the baby might not be suffering from an intussusception. The stomach was known to be large. Third, the *vomiting existed only four days*, which is a very short time previous to treatment by operation, as these cases go. The reason for operating without the usual interval of medical experimentation is that there had been no let-up in the symptoms, and the pyloric tumor was distinctly palpable. The child was 39 days old the day of the operation.

The operation was a posterior gastro-enterostomy. The child recovered well from the anæsthetic and feeding was immediately begun with a mixture of brandy and water with 1 ounce of whey. The baby took his food well until about the tenth day, when there was some vomiting and spitting up of food, which was relieved by a change in the food formula. He gained weight constantly except for one set-back and weighed 6 pounds and 10 ounces November 8, 1910. He was born on August 3, 1910, and weighed 4 pounds. The baby is now, October, 1913, three years old and is well. See Fig. 20 (1913).

CASE XI.—Wilson. A patient referred to the Massachusetts General Hospital from the Out-Patient Department, April 7, 1911. The operation was done by Dr. C. L. Scudder. A girl baby (colored). The baby's weight at birth was $7\frac{1}{2}$ pounds. She was breast fed for 6 weeks but vomited continuously from the time she was two weeks old. The vomiting occurred at about 10 minutes after each feeding. There was marked gastric peristalsis visible after taking food. See Figs. 21 and 22. The character of the vomiting was explosive. At the time of the operation, April 7, 1911, when the baby was seven weeks old, she weighed 7 pounds and 13 ounces. A hard tumor was palpable at the time of the operation. A posterior gastro-enterostomy was done. Following the operation there was an immediate and steady gain in weight. At the time the baby was discharged from the Hospital, May 22, 1911, she weighed 8 pounds and 2 ounces, and was in good condition. See Fig. 23.

CASE XII.—Dunham. A patient of Dr. H. A. Chase, of Brockton, referred from the Out-Patient Department of the Massachusetts General Hospital to the House for operation. The operation was done by Dr. C. L. Scudder, April 25, 1911. A boy baby. The child was given 2 breast feedings after birth which were immediately vomited. He was artificially fed from that time. No food agreed well and the vomiting was projectile. There was no bile in the vomitus and no gastric peristalsis was visible. A tumor about the pylorus could be felt which appeared to be a hard mass the size of a pea. See Fig. 24. His weight at the time of the operation when he was four weeks old was 6 pounds and 7 ounces. The operation was a posterior gastro-enterostomy.

Following the operation he was given brandy in small doses, and after five hours he was given hourly feedings of milk which were retained. The baby made a steady gain. A second operation was done 24 days after the first operation for a slight hernia in

the scar. He was sent home on June 3, 1911, in good condition, weighing 8 pounds and 2 ounces. See Figs. 25 and 26.

CASE XIII.—Bonney. A patient of Dr. A. O. Sprague, of Turner Center, Maine. The operation was done by Dr. C. L. Scudder, on August 25, 1911. A boy baby. He weighed at birth $7\frac{1}{2}$ pounds. The baby was breast fed for three weeks, which was supplemented by bottle feeding. He gained one pound in weight. The stools were normal yellow. He took his food well and did not vomit.

The baby began to vomit about the time he was weaned, when he was three weeks old. The vomiting was projectile and occurred some time after a feeding so that occasionally several feedings were vomited at a time. The food was varied. The stools were meconium-like. The baby cried very little but did not sleep much. At the time of the operation his weight was 6 pounds. The child was poorly nourished and so emaciated that the skin hung in loose folds on the limbs. Gastric peristalsis was visible, and a hard tumor could be felt to the right of the median line. A posterior gastro-enterostomy was done August 25, 1911. Death occurred at 1.19 A.M., on August 26, from shock.

Autopsy.—The stomach and the seat of the anastomosis was removed. The tumor was characteristic. The stomach was slightly dilated and the stoma was patent. There was no evidence of peritonitis. Death was evidently due to shock.

CASE XIV.—Nyman. A patient of Dr. Nason, of Newburyport, and of Dr. J. L. Morse, of Boston. The operation was done by Dr. C. L. Scudder, October 14, 1911. A boy baby. His weight at birth in July, 1911, was 7 pounds and 14 ounces. He was breast fed, supplemented with modified milk every other feeding up to the time the baby was weaned. The movements were normal for the first few weeks and then became loose and green in color. The movements continued the same in spite of changes in food. In August he began to vomit following almost every feeding taken, and did not vomit again until the next feeding. The baby was pale and weak. The abdomen was somewhat distended and rather tense. There was no tenderness, masses or fluid made out. The liver was slightly enlarged. No tumor or peristalsis was noted during observations made at times almost hourly and at times just after feedings in the Childrens' Hospital. The stools were typical starvation stools. The vomitus varied from 3ss to 3ii in amount, and was watery with much mucus and curds; it was once

bile stained, and twice stained with "old blood." The character of the vomiting was explosive always. The baby lost 200 grammes in weight during the medical treatment in the hospital.

On October 14, 1911, when the baby was 11 weeks old, a posterior gastro-enterostomy was done. The child made a good recovery from the operation and did well. Two months later, on December 20, 1911, he weighed 14 pounds.

In January, 1913, the mother reported that the child had been well as far as his digestion was concerned.

CASE XV.—Lewis. A patient of Dr. C. H. Staples, of Malden, A boy baby. At birth, September 27, 1911, he weighed 7 pounds. He began to vomit October 28, 1911. There was some constipation although fecal material had always appeared in the dejections. The vomiting was explosive in character and occurred every half hour. There was no bile in vomitus. The baby lost rapidly in weight.

A posterior gastro-enterostomy was done on November 11, 1911, when the baby was about 6 weeks old. A large tumor was found at the pylorus. The stomach was very much distended and dilated. The baby did well immediately after the operation, although very feeble. He did not vomit and lived for 4 days. His death was due to his previous starvation and to shock caused by the operation.

The pathological specimen of the stomach and intestines showed the anastomosis in good condition; there was no peritonitis.

CASE XVI.—Monsen. A patient of Dr. Fritz B. Talbot, at the Massachusetts General Hospital. The operation was done by Dr. C. L. Scudder, July 29, 1912. A boy baby. His birth weight was 10 pounds. He was breast fed the first week of life and appeared normal, taking his feedings well. At the beginning of the second week he began to vomit everything taken, and vomited continuously up to the time of the operation when he was three weeks old. His weight at this time had reduced to 9 pounds. No definite mass was found in the abdomen but a firmness and hardness was apparent to the left of the epigastric region. At the operation a tumor was found at the pylorus and a posterior gastro-enterostomy was done. The baby did well following the operation and was breast fed. He was discharged September 3, 1912, in good condition, having gained 130 grammes in 11 days.

On April 25, 1913, the mother reported the child to be perfectly well. An X-ray of the stomach was taken with bismuth and the stoma was seen to be functioning. He was 10 months old and weighed 22 pounds. The baby is now, October, 1913, over a year old and is perfectly well.

CASE XVII.—Cohen. A patient of Dr. Fritz B. Talbot, at the Massachusetts General Hospital. The operation was done by Dr. C. L. Scudder, August 26, 1912. A boy baby. His birth weight was 7 pounds. The baby was breast fed the first three weeks of life and was apparently normal. The fæces were normal and there was no vomiting. At three weeks old he began to vomit directly after each feeding and continued to do so up to the time of the operation. The vomiting was projectile in character. A definite tumor could be felt in the epigastrium. There was a marked loss of weight. At the operation, when he was 5 weeks old, a tumor was found at the pylorus and a posterior gastro-enterostomy was done. The baby was very weak and in spite of stimulation he died at midnight after the operation, August 27, 1912. At the autopsy the tumor was found at the pylorus and the gastro-enterostomy was intact.

TABULATION OF THE CASES OF PYLORIC STENOSIS.

No.	Age at operation.	Duration symptoms.	Time since operation.	Post-operative X-rays.
1	14 days	14 days	8 years	5 years, 1910. Food through stoma
2	24 days	24 days	8 years	8 years, 1913. Food through stoma
3	22 days	6 days	7 years	7 years, 1913. Food through stoma
4	25 days	11 days	5 years	5 years, 1913. Food through stoma
5	7 weeks, 5 days	3 weeks	5 years	5 years, 1913. Food through stoma
6	5 weeks	2 weeks	4 years	1 year, 1910. Food through stoma
7	13 weeks, 4 days	11 days	4 years	
8	4 weeks, 4 days	2 wks, 2 days.	3 years	
9	5 months	5 months	3 years	3 years, 1913. Food through stoma
10	5 weeks, 4 days	4 days	3 years	3 years, 1913. Food through stoma
11	7 weeks	5 weeks		
12	4 weeks	4 weeks		
13	6 weeks	3 weeks	Died	
14	11 weeks	8 weeks	2 years	
15	6 weeks	2 weeks	Died	
16	14 days	14 days	1 year	1 year, 1913. Food through stoma
17	5 weeks	2 weeks	Died	

INTUSSUSCEPTION.*

REVIEW OF TWENTY-SEVEN CASES.

BY FRANCIS OLCOTT ALLEN, Jr., M.D.,

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THE patients with whom this brief review is concerned were under the care of various members of the medical and surgical staff of the Children's Hospital of Philadelphia and comprise all those recognized as intussusception in that institution. The first case was admitted in September, 1897, and the last one in February, 1913, the total number in these 17 years being 27.

In the histories of these patients there is no hint of any racial or hereditary predisposition. There are representatives of the Negro, Italian, Hebrew, Russian, Irish, and other unnamed nationalities. No family histories of interest were given.

A large majority of the patients were under one year of age. All except one were under 17 months, the oldest being 3 years old, and the youngest 3 months. Seventeen were boys and 10 were girls.

It is impossible to find any definite exciting cause for the production of the intussusception. It occurred only once in July and once in August, the season when summer diarrhœa is most common, and when the largest number of cases might be expected, if diarrhœa were an important factor in the etiology. There were 5 cases in June, 5 in October, 4 in February, and at least one case in each month throughout the year. There was only one in which the history indicates that indiscretion in diet might be held responsible: a child, sixteen months old, had been weaned two weeks before the acute symptoms began, and was being fed on milk, oatmeal, barley, and rice. In 15 cases mention is made of the kind of food the baby was taking, and of these 13 were breast fed. So commonly is the patient a nursling, though the history does not always record the fact,

* Read before the Philadelphia Academy of Surgery, November 3, 1913.

that it is accepted at the hospital as axiomatic that patients with intussusception are breast fed infants. The seasonal distribution and the preponderance of infants at the breast are rather striking in view of the common assumption that diarrhœa and irregularities and disturbances of peristalsis are largely concerned in the production of the condition. Usually the histories make no mention of symptoms preceding the acute attack; in one case it is definitely stated that there were none, one baby was subject to frequent coughs, five had diarrhœa for a few days to a few weeks, and two had more or less vomiting and diarrhœa for a month. These intestinal symptoms seem just as likely to have been due to the onset of the intussusception itself as to any preceding affection.

The acute symptoms which brought the patient to the hospital were vomiting and bloody stools. Although in two histories these symptoms are not recorded and in two others only one is mentioned, the combination is so constant as to be characteristic of the condition. The shortest period during which these symptoms were present was 12 hours, the longest 8 days. As is to be expected the duration of these typical acute symptoms has a distinct relation to the mortality rate, under both operative and non-operative treatment. With one questionable exception, death occurred in every case with a duration of four days or more—8 deaths in 9 patients—while of the patients in whom the symptoms existed one day or less, with one exception, all recovered—1 death in 7 patients—although a second one in this group succumbed later to a recurrence. In the intermediate group of 11 patients, where symptoms lasted 36 hours to 3 days, there were 6 deaths and 5 recoveries.

The examination for abdominal and rectal tumor is recorded in 24 histories. In 3, no mass could be felt in either situation; in a few it was found in one, but not the other. It is evident that the tumor might easily escape detection by abdominal examination if the abdominal wall were distended and rigid, as it sometimes was, and, of course, the rectal mass can only be found when the intussusception has progressed far enough to come within reach of the examining finger. There

does not seem to be any definite relationship between the extent of the invagination and the severity of the disease. It so happened that all the patients in whom no rectal tumor was found died, and only one where the abdominal mass was confined to the right side recovered. It is probable that the extent of the invaginated bowel depends entirely upon the underlying anatomical conditions, and has little to do with the amount of strangulation and destruction of tissue. Indeed, it seems probable that the extensive intussusceptions are those which form easily on account of the great mobility of the bowel and the large size of the colon, and for the same reasons are those most easily reduced.

Of these 27 children, 20 were operated upon and 7 were not, and it is rather surprising, at first sight, to find that operation gave a mortality of about 66 per cent., while non-operative treatment gave a mortality of less than 50 per cent. Only seven of the 20 operative cases recovered, while 4 recovered without operation and 3 died. In spite of this distinctly better statistical result for non-operative treatment, a more careful consideration will show, I think, that immediate operation is always the treatment of choice. As so often happens in acute abdominal disease, other means are exhausted before operation is undertaken and, in statistical reports, the failures of non-operative measures are glossed over by the ultimate result of operation. Among these 20 operative cases, 5 are definitely stated to have been treated by enemata unsuccessfully before operation was done, and all 5 died after operation. These should be considered as non-operative failures, and it is probable that there were several more, but the records are too incomplete to identify them. In one of these 5 cases, an anal protrusion was first noted 8 days before; the patient, a boy of 8 months, was then etherized and given an enema in an attempt to reduce the invagination. This treatment failing, the child was turned over to the surgeon for a second anæsthesia and laparotomy. Death occurred 5 hours after operation. In another one, it is said that the condition had existed 5 days and several enemata had been given before admission to the hospital. At operation the

small intestine was found to be necrotic at the entrance to the intussusception and was excised. The patient died 22 minutes after leaving the table. In a third case an enema had been given each day for four days with no result but blood. At operation a volvulus was found in addition to the intussusception, and the ileum was gangrenous and perforated. The child died 2 hours later. Such instances as these form no basis for a plea for even a preliminary trial of enemata or other non-operative measures, but urge strongly that laparotomy be performed at the earliest possible moment. It is practically certain that all the patients who died after operation would have died without it, and it is possible that some of those who died without it might have been saved by it. As the proper execution of the injection treatment requires a fairly long anæsthesia to allow the fluid to slowly distend the colon and force back the invaginated bowel and as the danger of recurrence after reduction is a very real one, it seems hardly necessary to argue in favor of opening the abdomen during the anæsthesia and of anchoring the ileocæcal region after reduction.

The histories do not give many details of the operations. In general the abdomen was opened in or near the median line, the tumor found, and reduction attempted by making pressure on its distal end, gently forcing the invaginated portion out of the proximal end, as paste is squeezed out of a tube.

The type of intussusception found is not clearly described in many of the histories. Usually the ileocæcal region was invaginated into the colon; in one case, at least, the ileum was invaginated into the cæcum through the ileocæcal valve. In several cases serious complications were present: once a double intussusception, once a volvulus, sometimes gangrene and perforation, requiring resection and anastomosis or the leaving of the damaged gut in the wound. All of these complicated cases died. When such complications were not present and the invagination could be completely reduced, the cæcum or ileum was sometimes anchored to prevent recurrence, and, at other times, the abdomen was closed without that precaution. One case illustrates the importance of such a procedure. The intus-

susception was easily reduced and no complications were present; the abdomen was closed without anchoring the bowel. The child did well for 4 days and had normal bowel movements. Then bloody mucus appeared in the stools and the tumor recurred. The abdomen was reopened and the invagination again reduced, this time with some difficulty on account of adhesions about the cæcum. The intestine was sutured to the abdominal wall and the wound closed. The patient again did well, but pneumonia developed and death occurred on the third day. The method of fastening the bowel to prevent recurrence varied; once the mesentery of the ileum was shortened, once an injected appendix was removed and its stump sutured to the abdominal wall, and in two other cases the peritoneum of the cæcum was sutured to the parietal peritoneum. These four patients recovered. The only fatality following an operation in which the history records this step was the case just quoted when the patient died after a second operation. This is good evidence that the procedure is not, in itself, detrimental.

Within the last month I have attempted to trace the 11 survivors of the 27 patients admitted to the hospital. Unfortunately I have not been able to find the 4 earliest ones. The other 7 have been uniformly free from symptoms of intussusception. The first was operated upon 5 years ago and has had excellent health ever since. The second was operated upon 2 years ago, developed an incisional hernia, which was repaired in another hospital a year and a half later, but has otherwise been perfectly well. The third was operated upon 17 months ago and has remained well since. The fourth had an operation 14 months ago and is still in good health. The fifth has remained well since the operation 13 months ago. The sixth passed through an attack of measles while in the hospital convalescing from operation and was well until whooping cough developed, of which the patient died 9 months after operation. The seventh was prepared for operation 8 months ago, but the symptoms having abated and the tumor disappeared, operation was held in abeyance. There has never been a recurrence and the patient is now in good health.

From a study of these histories and a few of the patients themselves, it seems to me that, when the diagnosis is made, there is only one treatment which is proper to pursue. That cases are cured by rectal injections is evident from this report and many others. But to secure a permanent cure by this means the reduction must be made neither too early nor too late. If made before the serous coat of the bowel is sufficiently inflamed to produce adhesions, recurrence is to be feared. On the other hand, if attempted too late, after the layers of the intestine are adherent to each other, or gangrene or perforation has occurred, the injection must necessarily fail, as illustrated by several cases in this series, and may do great damage. Immediate operation is always indicated. The only step in the operation which these cases suggest is in need of emphasis is the anchoring by suture of the ileo-cæcal region. The delayed cases with serious complications are almost hopeless from the start.

The mechanism of the production of infantile intussusception is not satisfactorily explained. The underlying factors which make the invagination possible are, of course, anatomical, and consist of unduly long mesenteries of ileum and cæcum and, perhaps, unusual disparity in the calibres of the small and large bowel, allowing the parts involved to move freely within wide limits and encouraging the entrance of the smaller into the larger segment. It is not hard to imagine that, having once entered the cæcum, the folded mass forming the apex of the invagination may be forced onward by colonic peristalsis. The difficulty is to understand how the invagination starts. The theories usually ascribe its beginning to some irritation which induces irregular or excessive peristaltic action. But there is little evidence in these 27 patients that such is the case. The increase in diarrhoeal diseases during summer does not in the least increase the incidence of intussusception and, with a few exceptions, the histories of these patients do not conform to the theory. My own impression is that the occasional preceding diarrhoea is a result, rather than the exciting cause of the trouble, and that the condition depends chiefly, if not entirely,

on the defective anatomical arrangement. And I have wondered whether the invagination does not start in the physiological pouting of the ileocæcal valve, which may become exaggerated, on account of the laxity of the attachments of the intestine, until it is caught in the grip of the colonic peristalsis and forced onward, dragging the cæcum with it. There is only a small proportion of cases in which the ileum is found invaginated through the valve, but it may easily retract after the bulkier head of the cæcum becomes the apex of the intussusception.

Whatever the precise mechanism be, it seems probable that the formation and spontaneous reduction of intussusception is much more frequent than our records show, and that the condition occurs many times in infants who die or recover without a correct diagnosis being made. Take, for example, a history like this: seven weeks before admission, vomiting and blood in the stools; then cessation of vomiting and bloody stools; 3 weeks later treated in the dispensary for gastro-enteritis, the child doing well; later a return of vomiting and bloody stools; then a protrusion from the anus. This was almost certainly an intussusception with spontaneous reduction and a later recurrence. Another patient had vomiting and blood in the stools a month before admission, these symptoms lasting 10 days and then abating; 3 days before admission vomiting and bloody stools recurred. How many infants have had vomiting and bloody stools due to a temporary intussusception which was spontaneously cured it is impossible to imagine. Here are two who temporarily recovered, but in whom a complete cure was not effected spontaneously. These instances are sufficient to show that the condition is not one which, having started, progresses until the patient dies or is cured by treatment, but rather suggest that the anatomical defect allows of frequent invagination and reduction until the inflammatory changes hold the gut in one or the other position. The condition is diagnosed and treated only when swelling and other inflammatory reactions prevent spontaneous reduction and cause more or less

obstruction of the fecal current and hemorrhage from the congested mucous membrane.

If it be so that cases of intussusception recover without intervention on our part, the cure must take place as a result of inflammatory adhesions which hold the parts approximately in their normal relations. The descriptions of the findings at operation and autopsy are too incomplete for definite conclusions, but there seem to be certain points at which the bowel remains folded upon itself longer than elsewhere—stations in the progress of the invagination—and at those points inflammation is most marked and adhesions are most likely to occur. The ileocæcal region is practically always involved. In the right-sided tumors the apex of the intussusceptum seems to be blocked by the hepatic flexure, and the inflammation is confined to the ileum, cæcum, and ascending colon. In those where the tumor runs transversely across the abdomen, the angulation at the entrance to the intussusception is in the neighborhood of the hepatic flexure, so that adhesions may form there. In the cases of left-sided tumor the angulation occurs at the splenic flexure, and adhesions may be expected there.

Assuming that some of these various forms undergo spontaneous reduction and permanent cure, it is interesting to speculate upon the conditions which may be present in after life. The mobile cæcum of the adult seems like a direct continuation of the conditions underlying infantile intussusception. If the lower portion of the ileum slips in and out of the ileocæcal valve under certain anatomical conditions in infancy, and is finally prevented from doing so by the formation of adhesions which its own pernicious activity have produced, we should expect to find in later life, within a few inches of the ileocæcal junction, bands of adhesions shortening the mesentery, and on either side of this area an unusually long mesentery permitting ptosis of the proximal ileum and the cæcum, with the production of a typical Lane's kink. I think intussusception offers also a plausible explanation for the obstructing inflammatory bands at the hepatic and splenic flexures. Mr. Lane explains the formation of these bands and kinks which bear his

name by an elaborate theory based on the reactions of the parts involved to the application of lines of force, and considers them the result of the ptosed condition of the intestines. It seems to me that it is more reasonable to assume that they are the result of some such process as I have indicated. I am not aware that Dr. Jackson, either, has included intussusception among the possible causes of the pericolic membrane he has described, but, if intussusception does recover, it seems almost inevitable that such a pericolitis should be one of its sequels. And, finally, a spontaneously cured cæcal invagination will account for some of the curious and almost impossible situations in which an appendix may be bound by old adhesions

MODERN LABORATORY METHODS IN THE DIAGNOSIS OF SURGICAL DISEASES OF THE GENITO-URINARY TRACT.*

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THE universal tendency in modern medicine is to rely more and more upon the assistance afforded by the laboratory in the prophylaxis, diagnosis, and treatment of disease, and of all the specialties surgery is perhaps the one most in need of this aid.

In those diseases of the genito-urinary tract either distinctly surgical at the beginning, or ultimately demanding such interference, much may be learned by the clinician from the microscopist. Every surgeon when confronted with a difficult case naturally welcomes every suggestion that will aid him in arriving at a diagnosis, and the purpose of this paper is to call attention to methods that are of distinct value if pursued with persistent care and careful attention to detail. The various pathological and bacteriological tests long ago accepted as conclusive, and concerning which there is no dispute, will not be referred to, but I wish to emphasize as strongly as possible the value of a properly conducted microscopical examination of the urine. In nearly every disease of the genito-urinary tract the urine offers to the trained eye more diagnostic information than can be learned by any single manifestation or any group of subjective symptoms. Carrying with it as it does unmistakable evidences of the source, severity, character, and comparative duration of the inflammation, there remains only the necessary time and care in its examination to yield definite and conclusive results. That a trust-worthy diagnosis may be made without previous knowledge of the age, sex, or clinical history of the patient is undoubtedly true, but ordinarily it is

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safer not to be too positive in the interpretation of the findings without some understanding of the symptoms exhibited. Only the modest and conservative claim is made that the methods to be described will invariably result in confirming a diagnosis already made, or in giving valuable aid to clear up a case presenting many elements of doubt.

Accompanying every inflammatory condition of the genito-urinary tract are varying numbers of pus-corpuscles and red blood-cells, and always to be seen with them are epithelia of various shapes and sizes, desquamated as the result of the inflammation and which never appear in normal urine. Upon the ability to differentiate these epithelia and to say with certainty from what part of the genito-urinary tract most of them are derived the location of the inflammatory disturbance is dependent. It is not proposed to enter into a long discussion as to the views of various authors on this disputed point. It is enough to say that the claims of Louis Heitzmann in his book on "Urinary Analysis and Diagnosis" are enthusiastically accepted by many specialists, and that these claims cannot successfully be refuted by those who offer only a refusal to acknowledge them, unaccompanied by scientific argument to sustain their opinion. Heitzmann's views are extensively quoted by most modern authors, and will be, must be, eventually concurred in by all.

By a long series of experiments, covering many thousands of cases, it has been found that epithelia of a certain shape and size appear in the urine at the inception and during the progress of certain inflammatory conditions. Careful study of the urinary sediment in cases where the clinical symptoms admitted of no doubt as to the diagnosis, led to the belief that the epithelia always found in the given disease were directly derived from the organ affected. Following these observations to their natural and logical conclusion it has been demonstrated that certain epithelia appear in certain inflammations and are never seen in normal urine. On such an argument the differentiation of urinary epithelia is based, and it should be as convincing and as susceptible of proof as the diagnosis of the clinician

in a case of pneumonia, where long observation of the symptoms manifested allow of no hesitancy in the verdict.

At this point it should be understood that the claim is not made to label by a specific name every single epithelium appearing in the urine, but any inflammation of sufficient intensity to produce clinical evidences will result in the desquamation of a number large enough to warrant positive opinion as to their source. Many cases naturally present the difficulty of multiple involvement, necessitating careful study, but the embarrassment, if temporary, is never unsurmountable, the comparative number of the various epithelia present offering a sure guide as to the organ most affected.

It is hardly necessary to state that of all the epithelia found in urine those derived from the kidney are of the greatest practical significance, and fortunately at the present time there exists no difference of opinion as to the certainty with which they may be recognized. Many authors persistently refused even this concession until the study of specimens obtained by ureteral catheterization proved conclusively that these epithelia, always of a definite shape and size, appear in all diseases of the kidney. From the convoluted tubules the shape is round or oval, and in size one-third larger in diameter than the pus-corpuscle. Of about the same size, only columnar in shape, are those derived from the straight collecting tubules, and their presence in moderate or large numbers is usually indicative of a severe inflammation.

By reason of their importance, and for convenience of description, surgical diseases of the kidneys will be considered first, and perhaps one of the commonest is calculus. According to Keyes calculus in the kidney or its pelvis is the most frequent cause of renal suppuration, but I cannot agree with this author when he adds that "catarrhal inflammation is not encountered with calculus." As is well known to the clinician the symptoms vary greatly—all the way from an almost complete absence of subjective signs to a combination of intense renal colic, pressure and reflex pains, hæmaturia, and finally, suppuration and abscess.

The importance of careful X-ray study must be given great emphasis, and of course a positive shadow offers reliable information as to the presence and location of the stone, but as about 75 per cent. of all calculi are composed of uric acid the findings are frequently negative or doubtful. Examination of the urine in these cases will often clear up the diagnosis, and the microscopical picture will vary with the extent and duration of the inflammation. Some observers lay great stress upon the presence of a moderate or large number of red blood-cells in the urine, but if the source of the trouble is to be positively determined they must be accompanied by characteristic epithelia from the kidney, and ureter. Crystals of uric acid gravel in large numbers, particularly the rarer forms of stellate and needle-like concretions, together with renal epithelia, pus-corpuscles, and red blood-cells, offer, if not positive evidence, at least a strong possibility of the presence of a stone.

Suppurative pyelitis caused by calculus in the pelvis of the kidney, may be diagnosed by the above features, accompanied by a large number of pus-corpuscles and the presence of a preponderating number of epithelia from the pelvis of the kidney and the ureter. The former (pelvic epithelia) are characterized by round, oval, or lenticular shapes, are much larger than those derived from the kidney, while smaller than those of bladder origin; and the latter (ureteral epithelia) are usually round and twice the diameter of the pus-corpuscles.

Strongly suspicious of calculus in the pelvis or an impacted stone in the ureter is the sudden change from features pointing markedly in that direction to an almost complete absence of the same. This calculous anuria is by no means uncommon, and the features shift from time to time as the urine flow is obstructed or released. I saw this beautifully illustrated not long ago in a case operated upon by a prominent surgeon of this city. I had the privilege of following the case for some time before operative interference was decided upon. Repeated X-ray examinations always produced a shadow on the left side three inches above the bladder, and the ureteral catheter was arrested at that point. The microscopical picture of a

possible calculus was not as pronounced as is sometimes depicted in these cases, but my diagnosis of calculus was based on the fact that the features appeared and disappeared at intervals, two specimens in one day showing totally different findings. The patient was operated upon, extensive incisions being made, the bladder opened, and no stone found. Three weeks later he had another attack of renal colic, returned to the hospital and acted as his own surgeon by passing a stone so large that meatotomy was necessary for its final delivery.

Another important factor in the diagnosis of renal calculus is the appearance of the epithelia when the pressure of a foreign body exerts itself, or hypertrophy of the organ affected is co-existent with other symptoms of inflammation. This pressure results in the production of so-called endogenous new formations or inflammatory corpuscles within the epithelia, and these formations are never present in large amount except in pressure of some kind.

Pyonephrosis of tubercular origin offers in the urine both macroscopic and microscopic points of diagnostic value. The urine is usually heavily turbid, and if allowed to stand the pus separates itself into a thick creamy layer at the bottom of the glass, the supernatant fluid being clear. This is in marked contrast to the persistently turbid appearance of urine voided in ulcerative cystitis, or the residual urine in a case of prostatic hypertrophy where the bacteria of decomposition will not allow of such a separation.

At first glance it would seem that the clinician should not long remain in doubt over a suspected case of renal tuberculosis, but there are many where the family and personal history, and the objective and subjective symptoms offer little or no help. Particularly difficult is the diagnosis between renal tuberculosis and an ascending colon bacillus infection. Often the only prominent feature is pyuria, and the laboratory is invoked to ascertain the cause. Search for the tubercle bacillus, while so often unproductive, often fails because the proper technic is not observed. The urinary sediment should be as concentrated as possible, obtained first by sedimentation, then by the

added power of the centrifuge, and many slides should be examined before the search is abandoned and the findings declared negative. The next procedure is usually the inoculation of a guinea pig, this of course frequently making the diagnosis positive, but even before these methods are indicated by the gravity of the case, microscopical examination of the urine will often yield valuable information, at least in pointing the finger of suspicion toward a possible tubercular process. Tubular casts are sometimes present, though not often, the chief features being a large number of pus-corpuscles, few red blood-cells, connective-tissue shreds, fat globules free in the field and studding the epithelia, and epithelia from the convoluted tubules, straight collecting tubules, and pelvis of the kidney.

A clue of great value is supplied by the appearance of the pus-corpuscles, which in a tubercular infection indicate with unfailing accuracy an impaired constitution. This diagnostic point was first announced and demonstrated by Carl Heitzmann and one has only to study a sufficient number of cases to be convinced of its soundness and practical value. Pus-corpuscles indicative of a good constitution appear in freshly voided urine as coarsely-granular, rather highly-refractive cells with no visible nucleus. As the constitution becomes impaired the granulation appears finer, the refraction diminishes, until finally the regular contour is lost, the edges are ragged, and one or more nuclei come into view. A combination in a given case of two or more of the varieties described, for example, a number of coarsely-granular, highly-refractive corpuscles in company with others of pale, finely-granular, irregularly-shaped, nucleated appearance would indicate an originally good constitution now impaired by disease. Because I have touched upon this point while discussing tuberculosis it must not be understood that its diagnostic value is applicable only to this disease. The same information is at our disposal in any inflammation of the genito-urinary tract of sufficient severity to produce pus-corpuscles in numbers large enough for comparative study.

Before leaving the subject of renal tuberculosis I wish to

refer with great emphasis to the extreme importance of obtaining by the ureteral catheter specimens from both kidneys so that both may be studied before surgical relief is attempted. The reasons are obvious, (1) to avoid the catastrophe of removing one kidney in the congenital absence of the other; (2) to ascertain positively whether the disease is unilateral or bilateral; (3) to estimate through the chemical and microscopical findings the degree of functional activity exhibited by one or both kidneys.

Estimation of the renal function has been attempted by means of chemical tests over and over again, each new process attracting for a time more or less enthusiastic attention, but one after the other all have been discarded as practically valueless. Cryoscopy, always cumbersome in the technic, has been proven entirely worthless, as in many cases where one kidney known to be badly diseased and the other performing the functions of both, it has been shown that the freezing-point varied little or not at all. Much was expected of the numerous forced elimination tests with urea, sodium chloride, water, and the dye-stuffs, but the consensus of opinion now is that they are of no value in estimating the functional activity of the kidneys. The injection of phloridzin, setting up an artificial diabetes, with the appearance of sugar in the urine in about one-half to one hour in normal kidneys, and its failure of elimination in nephritis indicates only that the renal function is somewhat disturbed, and the results are never uniform. More promising in its accuracy than any other is the phenolsulphonephthalein test, recently devised by Rowntree and Geraghty, but it can hardly be carried out by the general practitioner, and even in the laboratory involves the employment of much time and work to obtain results more easily arrived at in other ways. These tests have been briefly referred to only to be condemned, for it is difficult to understand why time should be wasted on them when microscopical examination affords such positive proof of all that we desire to know regarding renal sufficiency or insufficiency. As already stated the urine from each kidney must be collected by the ureteral

catheter, simultaneously and for the same period of time. Chemical and microscopical examination of the two specimens will indicate conclusively the extent and location of the disease, and the constitution of the patient being determined at the same time by a study of the pus-corpuscles, the surgeon has at his disposal all the information necessary to a prompt decision as to the advisability or contra-indication of operation.

Malignant disease of the kidneys may often be diagnosed by microscopical examination of the urine, and aids the surgeon considerably when the clinical symptoms are either vague, or confused by the severity of some co-existent infection.

Sarcoma may occur at any age, and at its inception, before the ulcerative process is established, is difficult of diagnosis. To admit of a positive opinion there must be present in the urine large masses or shreds of connective-tissue and the characteristic sarcoma corpuscles in large numbers. Connective-tissue in the urine does not receive the attention it deserves, probably because it is so often confounded with mucus or extraneous matters such as cotton and linen fibres. It consists of wavy, moderately-refractive fibres, having a tendency to form into bundles, and is found in ulcerative, suppurative, hemorrhagic, and traumatic inflammations. Especially marked in ulcerative processes of malignant origin, these shreds, filling as they sometimes do an entire field, and studded as they occasionally are with inflammatory corpuscles, are enough of themselves to warrant a diagnosis of malignant tumor. In combination with sarcoma corpuscles, which present the appearance of small, round, highly-refractive, even glistening cells, without nuclei, larger than red blood-corpuscles and smaller than pus-corpuscles, the diagnosis of sarcoma is positive.

Cancer of the kidney is difficult of diagnosis from the urinary findings alone, but when large masses of connective-tissue, filled with large multi-nucleated epithelia are seen, accompanied as sometimes occurs by typical cancer nests, the suspicion of cancer is usually confirmed by the ultimate clinical history of the case.

Surgical diseases of the bladder due to tumor are not sus-

ceptible of positive diagnosis until the ulcerative process has begun, but when desquamative shreds of the tumor are voided in the urine no difficulty should be experienced. What has been said of sarcoma and cancer of the kidney applies equally to similar growths in the bladder. Hæmaturia is one of the first and most prominent symptoms, and even before the disease has advanced to the stage where connective-tissue shreds, sarcoma and cancer corpuscles, and evidences of a chronic inflammatory process contribute to a positive conclusion the characteristic bladder epithelia are always present. With the exception of those from the vagina, bladder epithelia are the largest seen in urine. From the upper layer, a few of which appear in normal urine, the shape is the familiar pavement or squamous form. This changes to a spherical or oval contour (from the middle layer) when the inflammation becomes more intense, and the columnar variety (from the deepest layer) is the product of deep-seated infection or ulceration. In diseases of the bladder, as of the kidney, prostate, or any other part of the genito-urinary tract, the location of the inflammation and the ultimate diagnosis are absolutely dependent upon the differentiation of the epithelia always accompanying the other features in the case.

Papilloma of the bladder should especially be mentioned, because of its comparative frequency, and the striking microscopical evidences in the urine when this benign tumor is present. Hemorrhage, of course, is a prominent symptom, sometimes so profuse as to obscure more or less the other features, but rarely absent are the peculiarly-shaped connective-tissue shreds, once seen never forgotten, and of themselves almost pathognomonic. These shreds are very long, very irregular, having a tendency to coil or knob-like formations, and frequently contain fat globules or inflammatory corpuscles. With these features are pus-corpuscles and epithelia from the various layers of the bladder, particularly the columnar, many of them containing fat globules and the endogenous new formations indicative of pressure.

Intimately associated with the bladder is the prostate gland,

and diseases of this organ requiring surgical interference are common enough, and the diagnosis at times sufficiently obscure to demand whatever assistance the laboratory affords. Acute and chronic prostatitis, usually gonorrhœal in origin, seldom necessitates actual surgical aid, but abscess formation is of frequent occurrence and often goes unrecognized until rupture occurs. The diagnosis of such a condition is dependent upon the presence in the urine of a large number of pus-corpuscles, sometimes entirely filling the field, connective-tissue shreds, red blood-corpuscles, and epithelia from the prostate gland and its duct. These epithelia are about twice the size of pus-corpuscles, larger than those from the convoluted tubules of the kidney, and cannot be differentiated from those of ureteral origin, which are of the same shape and size. In prostatic abscess, however, the bladder and urethra are also involved, and the presence of epithelia characteristic of these organs will easily locate the inflammation, as in renal disease epithelia from the convoluted and straight collecting tubules and pelvis of the kidney enable us to eliminate the prostate as entering into the situation. The diagnosis of the majority of prostatic inflammations is rendered more simple by the presence in many cases of epithelia from the seminal vesicles and ejaculatory duct, but their surgical importance being negligible detailed description of them is omitted.

The urine in prostatic hypertrophy, especially of the senile type, presents another opportunity for positive diagnosis, oftentimes extremely valuable in hypertrophy of the so-called median lobe which has escaped the touch of the surgeon's examining finger. When the condition has reached the stage where urinary flow is obstructed and residual urine is always present, the bacteria of decomposition, of course, point strongly toward the prostate as being responsible. The epithelia from the prostate in such a case are always more or less filled with fat globules indicating chronicity, and endogenous new formations due to pressure of the enlarged gland. Epithelia from the neck of the bladder and those from the deeper layers of

the bladder itself are always present, as there is naturally an accompanying secondary cystitis.

It follows logically that this bacterial invasion and infection of the bladder cannot be long continued without an extension of the process through the ureters into the kidneys, and many cases of pyelonephritis are of such origin. This possibility, at times a dangerous complication of prostatic hypertrophy, necessitates careful study of the urine before operation is advised or attempted. Too many of these cases die shortly after operation, the mortality being ascribed to any but the real cause, *i.e.*, functional insufficiency of the kidneys. There should be no difficulty in making the diagnosis, and at the same time the surgeon is accurately informed as to the resistance apt to be exhibited by the patient.

The prostate is at times the seat of malignant disease, and such a diagnosis is made in the same manner as previously described when the kidney or the bladder becomes the host of this unwelcome visitor.

Stricture of the urethra presents a typical urinary picture, but is of no practical importance, as the clinical symptoms are clear, and routine examination by the surgeon leaves no doubt as to the diagnosis.

In conclusion I must ask your indulgence for the necessarily rough outline of the subject presented. Its importance is vital enough to deserve better and more detailed treatment, but I hope I have sufficiently accentuated the need of employing every modern laboratory test in the diagnosis of surgical diseases of genito-urinary origin, and the absolute necessity of determining before operation the functional power of the kidneys by microscopical examination of the urine.

A TECHNIC FOR PERFORMING A SHOCKLESS SUPRAPUBIC PROSTATECTOMY.

BY W. E. LOWER, M.D.,

OF CLEVELAND, OHIO.

THE shock-producing factors of a prostatectomy are first, the effect of the anæsthetic; second, the *amount* of painful traumatism; and third, the hemorrhage. In so far as any of these factors can be minimized, post-operative shock will be lessened; if they can be eliminated then the operation becomes shockless and may be performed without hesitancy upon patients who, because of their age or because of diminished vitality from any cause, have been considered bad operative risks.

After a considerable experience and the trial of many different methods to diminish the dangers of this operation, the following technic has been evolved. Patients undergoing a prostatectomy performed by this technic are not only free from shock but are in splendid condition to combat any other untoward influence that may arise during convalescence.

TECHNIC.

1. An hour before the operation the patient is given a hypodermic injection of morphine and scopolamine, the size of the dose depending upon his age and condition.

2. Immediately before the operation the bladder is irrigated and 60 to 90 c.c. of a 5 per cent. solution of alapin is injected through a catheter, the catheter is clamped, and both catheter and solution are allowed to remain.

3. Nitrous oxide-oxygen is administered by an expert anæsthetist; this anæsthetic when administered by one trained in its use being safer than ether and to some extent in itself a preventive of shock.

4. The bladder is approached in the usual way, except that the skin incision and every division of tissue is preceded by a thorough infiltration with novocaine in 1-400 solution (Fig. 1).

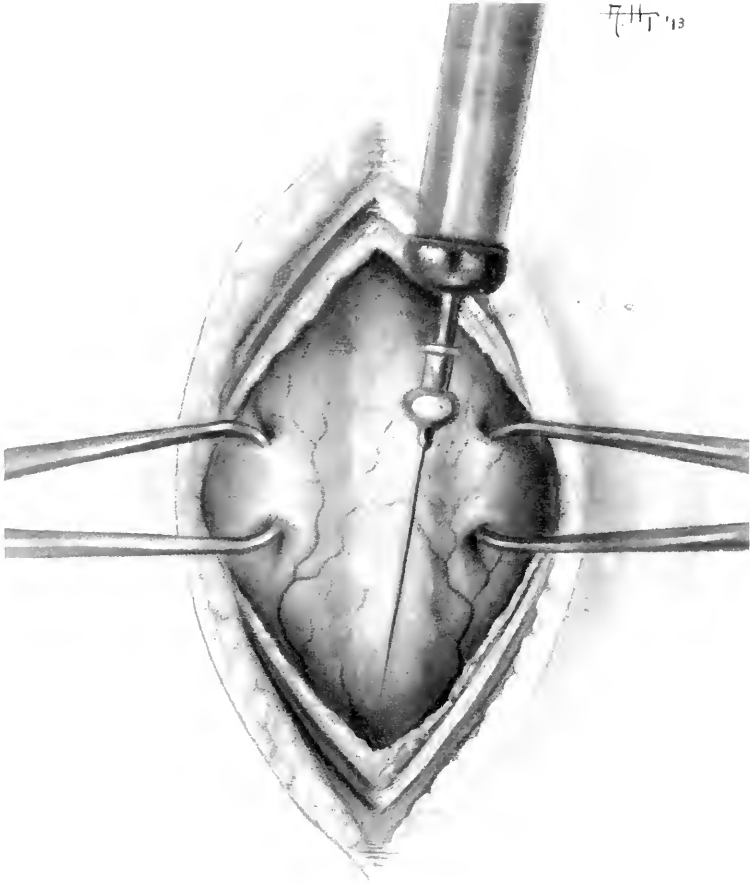
FIG. 1.

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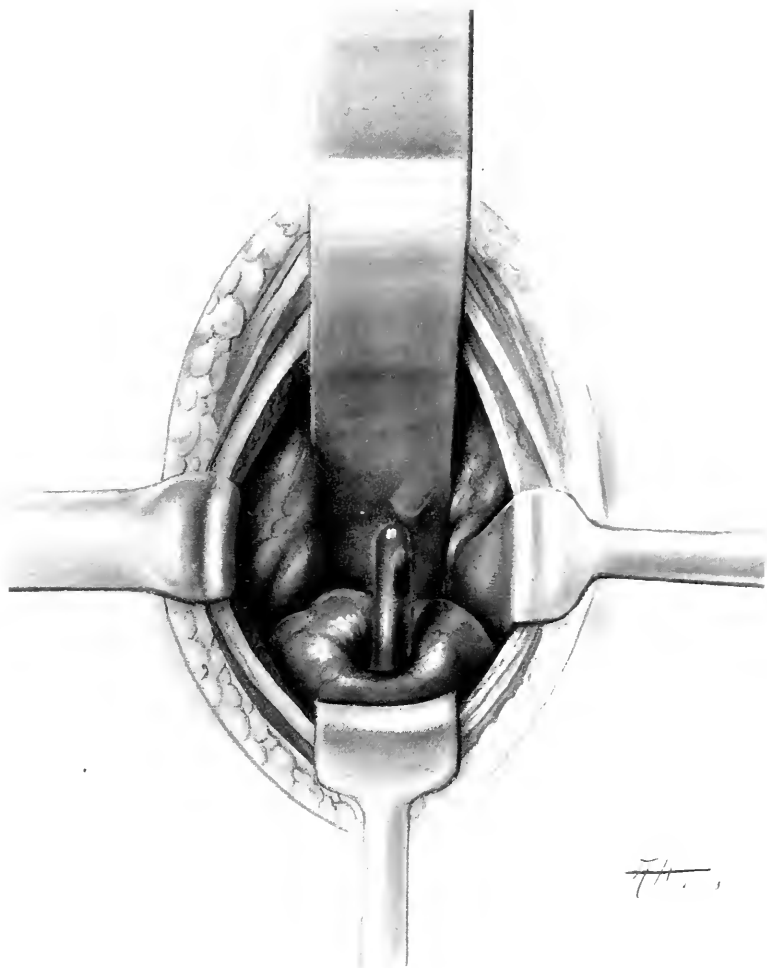
Infiltration of skin and fascia with novocaine.

FIG. 2.



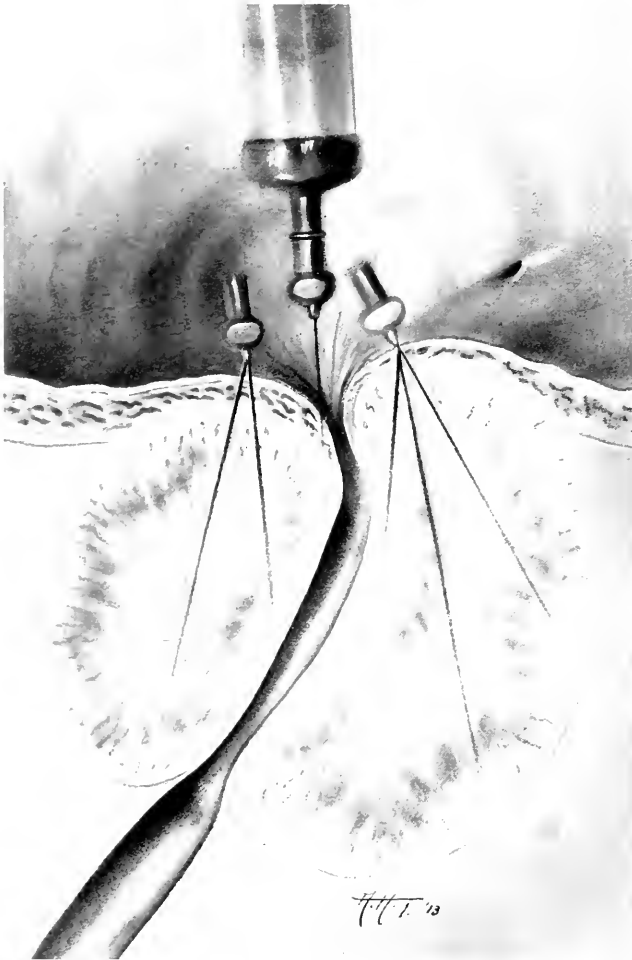
Infiltration of bladder wall with novocaine.

FIG. 3.



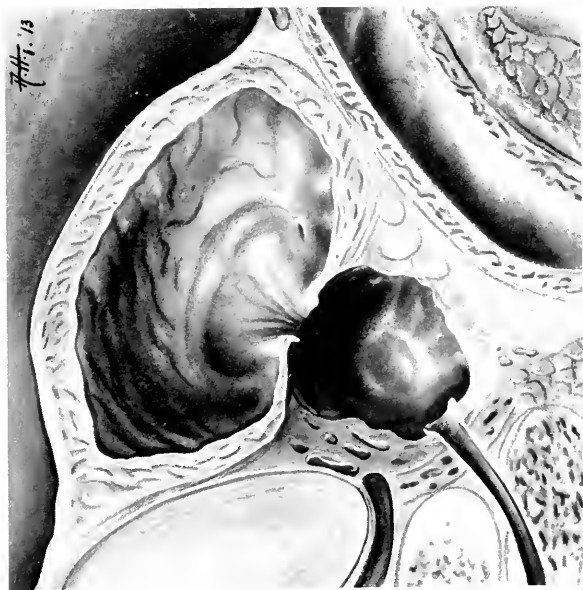
Intravesical exposure of prostate.

FIG. 4.



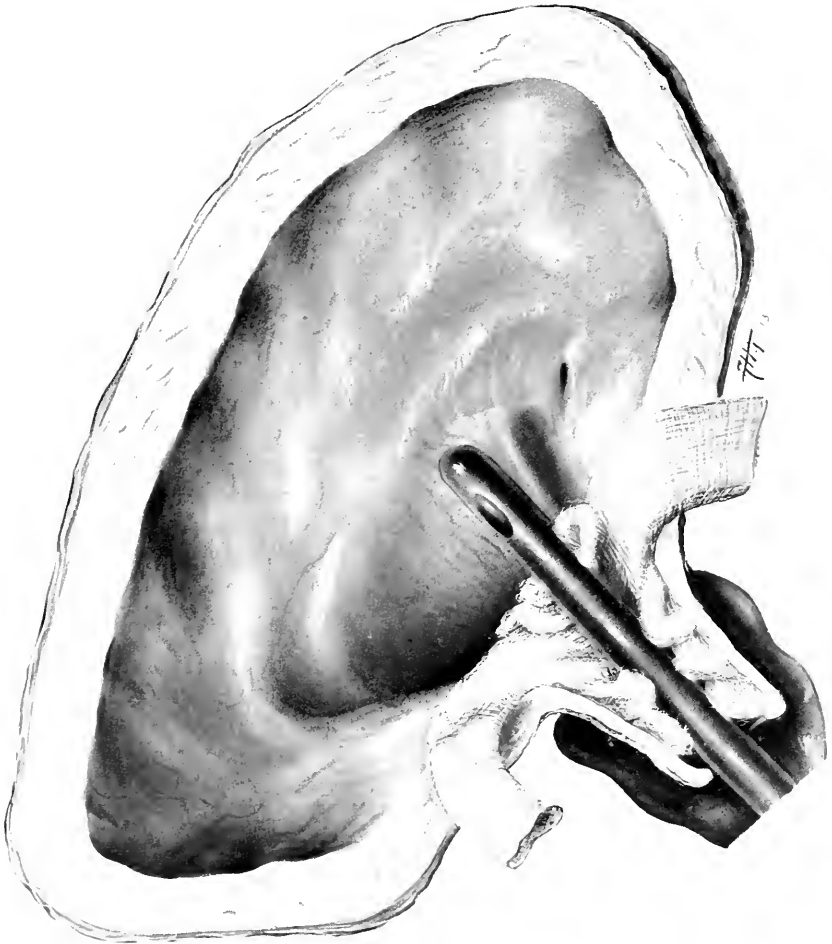
Deep infiltration along edge of capsule of prostate before removal.

FIG. 5.



Cavity left after enucleation of prostate.

FIG. 6.



Gauze packing by which the raw surfaces of capsule are brought in apposition.

5. When the bladder is exposed, it is elevated with curved bladder hooks and the bladder wall is thoroughly infiltrated with the novocaine solution (Fig. 2).

6. By gentle retraction and without injuring the cut edges of the bladder wall, the prostate is exposed intravesically (Fig. 3).

7. The bladder mucosa on the projecting prostate is infiltrated with novocaine, and along the edge of the capsule a deep infiltration is made (Fig. 4).

8. With careful and most gentle manipulations the prostate is enucleated with the finger (Fig. 5).

9. Narrow strips of gauze are packed along the side of the catheter on top of the mucous membrane so that the raw surfaces of the capsule are brought in apposition, a procedure which effectively prevents hemorrhage (Fig. 6). The two ends of the urethra are thus brought together, so that a continuous funnel-shaped mucous membrane is produced—a most important factor.

At the close of this operation the color of the patient will be good; the pulse and respiration will not be increased, in fact, may be even lower than before the operation. The patient will rest comfortably, will be free from nausea and mucus, can take water early, and a speedy, uninterrupted convalescence may be looked for.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting, held November 3, 1913.

DR. JOHN H. GIBBON, Vice-President, in the Chair.

ARTHROPLASTY FOR ANKYLOSIS OF ANKLE.

DR. ASTLEY P. C. ASHHURST presented a boy, aged eight years, who caught his right foot in the machinery of a grist mill, two years before coming under observation. Most of the soft parts on the inner side of the foot and ankle were torn away exposing the bones. Subsequently there was a great deal of sloughing, infection extended up the inner side of the leg nearly to the knee, and the boy was completely disabled for a long time. Part of the third toe was lost. On June 15, 1913 he was brought to the Orthopædic Hospital and admitted to Dr. Harte's service. The wounds had only recently healed: there were long scars densely adherent to the underlying bones all along the inner side of the foot and ankle, and up the inner surface of the leg almost to the knee. The foot was in a position of equinus, at 140 degrees with the leg, and there appeared to be bony ankylosis at the ankle (Fig. 1). This supposition was confirmed by a skiagraph, which showed ankylosis also of most of the tarsal bones, all bony outlines being obliterated (Fig. 4). The boy walked on the toes with the foot in a position of marked equinus and slight varus, and with the great toe in marked hallux valgus deformity (Fig. 5). There was nothing but scar tissue on the inner side of the foot and ankle, and this was densely adherent to the bone, absolutely no soft tissues being left. Careful and skilful massage was given for over seven weeks, but though some improvement occurred in the nutrition of the skin most of the cicatrices remained densely adherent to the bones. At length operation was decided on, and it was planned by Dr. Ashhurst to excise a wedge of bone of sufficient size to bring the foot up to

FIG. 1.



Bony ankylosis of ankle-joint in position of equinus (140°).

FIG. 2.



Showing external incision for arthroplasty of ankle.

FIG. 3.



Result of arthroplasty of ankle.

FIG. 4.



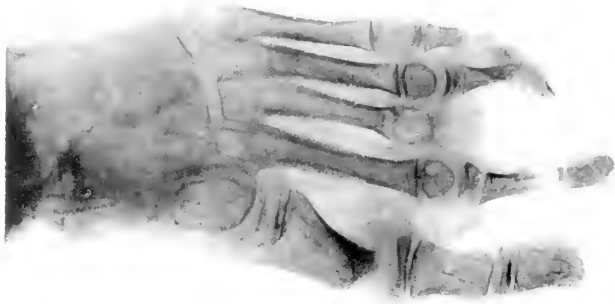
X-ray of ankylosis of ankle-joint in position of equinus.

FIG. 5.



X-ray showing traumatic hallux valgus, etc.

FIG. 6.



X-ray showing result of operation for hallux valgus.

FIG. 7.



X-ray showing lateral view of foot after arthroplasty of ankle-joint. In lateral view the new joint can be seen a short distance below the epiphyseal line of the tibia. In the anteroposterior view it can scarcely be seen.

a right angle with the leg, and then, if it had been found possible to preserve the lateral ligaments, so as to ensure stability of the foot on the leg, to transplant a piece of fascia lata between the bones, thus providing for motion at the ankle-joint. The loss of the subastragalar joint is much less disabling than that of the ankle-joint, and even in performing an arthrodesis of the ankle-joint in cases of infantile paralysis it is better to secure firm fibrous rather than actual bony ankylosis, so as to promote locomotion.

Operation, August 7, 1913: Dr. Ashhurst. Ether. Esmarch band above the knee. An incision was made on the outer side of the tarsus from below the external malleolus forward above the peroneal tendons as far as the extensor tendons (Fig. 2). This incision was carried to the bone, and all the soft parts were raised from the bones across the dorsum of the foot and ankle. Another incision, about an inch in length, was then made on the inner side of the ankle-joint, just in front of the internal malleolus and parallel to the shaft of the tibia. This incision had to pass through the old cicatrix adherent to the bone. The inner and outer wounds were then joined by burrowing from one to the other between the bones on the dorsum of the ankle and the overlying soft parts, thus raising all extensor tendons and the anterior tibial vessels out of harm's way. Next a wedge of bone was cut out by means of osteotome and gouge; the wedge had its base on the dorsum of the tarsus, and its apex at the posterior surface of what used to be the ankle-joint. After this wedge was removed, and the foot rendered movable on the leg, the next task was to excavate the tibio-fibular mortise. Then the foot came up to a right angle with the leg. Having preserved the lateral ligaments it was now found that there was only slight lateral mobility and tendency to valgus deformity (there had been varus deformity previously); therefore, it was determined to insert a flap of fascia lata so as to preserve the motions of the ankle-joint. Owing to the dense cicatrices all around the ankle and foot there was no possibility of employing a pedunculated flap. Accordingly an incision was made over the left thigh, and a piece of fascia lata and muscle was cut free at the point where the tensor fasciæ femoris is inserted. This transplant was two inches square and about one-quarter of an inch thick. The transplant was then placed in the new ankle-joint, and stitched in place with chromic

gut; there was no tendency for it to be displaced. The external incision at the ankle was closed in two layers, but the inner incision, through scar tissue previously adherent to the bone, permitted of closure only in a single layer of skin sutures. The operation took about one hour. The foot was dressed in plaster of Paris.

The plaster case was removed in two weeks, and the wounds were found healed. Some motion was possible in the ankle-joint. Three weeks after operation passive motion was begun; there was free voluntary motion of about 10 degrees, but the foot did not come up quite to a right angle with the leg. It might have been better to have lengthened the tendo Achillis at the first operation, but this was postponed because of the poor vitality of the tissues in which the arthroplasty was done.

Second operation, October 2, 1913 (eight weeks after the first operation): Dr. Ashhurst. The hallux valgus caused extreme deformity (Fig. 5), and it was planned to correct this as far as possible, and at the same time to lengthen the tendo Achillis so as to permit flexion of the ankle beyond 90 degrees. The old scar tissue was densely adherent to the projecting head of the metatarsal, but by turning up a flap with its convexity over the proximal phalanx good exposure of the metatarsal joint was secured. The head of the metatarsal was removed, and the toe brought around into proper position. The long extensor of the toe had sloughed away at the time of the original injury, and the only soft tissue which could be utilized to interpose between the sawn surface of the metatarsal and the base of the phalanx was the tendon of the abductor hallucis. This was accordingly turned into the new joint, and the soft parts closed. Then the remaining stump of the third toe was removed, the deforming cicatrix which covered it was excised, and an Agnew operation for webbed fingers was done to restore the contour of the toes as far as possible. The improvement in position is readily seen by comparing the X-rays made before and after operation (Figs. 5 and 6). Finally the tendo Achillis was lengthened by the usual Z operation. When the tendo Achillis had been divided it was found that free motion was possible in the ankle-joint: flexion to about 70 degrees, and extension to about 120 degrees. The foot was dressed in plaster of Paris at an angle of about 80 degrees with the leg.

The plaster case was removed October 23, three weeks after operation. There was a little sloughing of the margins of the flap over the metatarso-phalangeal joint of the great toe, but the other incisions were firmly healed, and the deformity was almost entirely overcome (Fig. 7). Passive motion was instituted, and the boy encouraged to walk around. Examination November 1, 1913, showed that he had free voluntary motion in the ankle from 85° to 95° ; and that passive motion was possible from 85° to 110° .

The patient was shown at this meeting, Dr. Ashhurst said, because he would leave for his home in Maryland before the next meeting. It is hoped that it will be possible to report improved motion at a future time.

RESULT OF EXCISION OF WRIST FOR TUBERCULOSIS.

DR. ASHHURST presented a man, twenty-eight years old, who came under his care in August, 1912. When four years of age he had suffered from tuberculosis of the right hip; a cold abscess formed and was opened, but healed soon. He was under treatment for the hip condition until the age of 8 years, being confined to bed 18 months, and on crutches for nearly 3 years. He eventually secured a very useful limb, with fair motion at the hip-joint, but with shortening and adduction, which caused a marked limp. The hip remains weak, and is subject to slight injuries. He walks on his toes.

In February, 1912 he fell and injured his left wrist, and was treated for five or six weeks on a splint for what was considered a fracture of the radius and two of the metacarpal bones. The wrist never became normal, but remained swollen and painful and perfectly useless. In June, 1912 he applied to the Surgical Dispensary of the Episcopal Hospital, and came under the care of Dr. Carmany, who recognized the true condition as tuberculous (Fig. 8), and dressed the wrist on a palmar splint. In August, when Dr. Ashhurst went on duty in the Dispensary, an attempt was made to secure more absolute immobilization by the use of a plaster-of-Paris splint, applied to the dorsum of the forearm and hand, with the wrist in slight hyperextension. Although temporary improvement took place for a few weeks, the disease then began to progress: the joint was hot, red, and painful; the entire carpus was puffed up, on the flexor and extensor surfaces;

the fingers were stiff and useless, and though the skin was in good condition and no sinuses were present, it was not considered safe to persist in conservative treatment, especially as the patient had another (healed) tuberculous lesion in the hip, and it was feared this might light up again. A skiagraph made at this time (early in September, 1912) showed involvement of the radius and ulna, all the carpal bones, and the bases of all the metacarpals, except that of the thumb. Unfortunately this plate was broken.

The patient was admitted to Dr. Frazier's service in the Episcopal Hospital.

Operation, September 6, 1912: Dr. Ashhurst. Ether. Esmarch band below elbow. The dorsum of the hand was split between the index and middle fingers, the incision extending on to the radius above the wrist, and being continued through the web of the fingers on to the palmar surface of the hand for about an inch. The extensor tendons were turned aside, the wrist-joint was opened, and the ends of the metacarpals cut off with osteotome; the ends of the radius and ulna were removed in like fashion. Most of the carpus was removed in one mass, but the unciform, the scaphoid and trapezium had to be removed piecemeal. The end of the thumb metacarpal was not cut off, as it appeared to be healthy. The synovial membrane, and the tendon sheaths on the flexor and extensor surfaces were all invaded by the granulomatous tissue, and a rather tedious dissection was required to remove them. The Esmarch band was removed before any sutures were introduced, and there was very little bleeding except from one large branch of the radial which required ligation. The radius was then drilled in two places, and one drill hole was made in each of the metacarpals of the index and middle finger and a suture of aluminum bronze wire was used to approximate the hand to the radius, in the hope of securing firm bony ankylosis and thus arresting the disease. The soft parts were closed with chromic gut sutures; and a small drainage tube was left in the wound. The hand was dressed in almost full pronation, in slight extension, and fixed by anterior and posterior splints of gypsum. The time of the operation was an hour and a half.

Two days later the drainage tube was removed, without disturbing the deep dressings. The first dressing was made ten days

FIG. 8.



Tuberculosis of left wrist June 7, 1912; duration 4 months.

FIG. 9.



Excision of wrist, 7 months after operation (March 29, 1913).

FIG. 10.



FIG. 11.



FIGS. 10 and 11.—Result of excision of wrist for tuberculosis—limits of supination and pronation.

after the operation, when the wound was found healed except at the point where it had been drained.

Subsequently a sinus formed on the anterior aspect of the wrist over the radius. This was dressed with mercurial ointment, and the hand was kept at rest in a gypsum splint. The sinus remained moist until the end of January, 1913, more than four months after operation; but during all this time the wrist was painless, and gave no evidence of active disease.

A light brace was now ordered, and when seen in March, 1913, the patient was regaining considerable use of his hand, and had fair strength in his fingers, and good thumb motion.

Examination, October 20, 1913, over a year since operation (Figs. 9, 10, 11): The patient keeps a cigar store, and has no discomfort in the wrist except on violent motion. He can lift and carry almost any weight with the arm extended, the force being applied in the long axis of the hand and forearm; but the hand is weak if force is applied at right angles to its long axis. He goes hunting, and uses his left hand to hold the gun, without difficulty. He can oppose his thumb to the index and middle fingers, but not to the ring and little fingers. His grip is strong. There is rotation in the forearm from a position of almost full pronation to beyond mid-supination (90°). There is slight hypæsthesia in the ulnar distribution to the fourth and fifth fingers. The hand inclines to the radial side, and the head of the ulna is prominent on the dorsum. There is scarcely any motion in the wrist-joint. The wire suture causes no symptoms, but appears to be palpable on the extensor surface of the wrist.

CONGENITAL DEFORMITY OF THE AURICLE AND EXTERNAL AUDITORY MEATUS, WITH LOP EAR.

DR. ASHHURST presented a boy, now eleven years old, with a congenital deformity of the left ear. Apart from the disfigurement produced by the lopping over of the pinna (Fig. 12) and the existence of supernumerary auricular cartilages on both sides of the head, the external auditory meatus was absent (Fig. 13). Dr. T. S. Stewart, skiagrapher to the Episcopal Hospital, who made an X-ray examination, thought the skiagraph showed no evidence of a middle ear. But Dr. C. C. Eves, aurist and

laryngologist to the hospital, who very kindly examined the boy, reported as follows:

"Yesterday I examined your patient, Elmer W., and demonstrated that without a doubt there is present a patent Eustachian tube on the left side. The Eustachian catheter was easily introduced into the opening of the tube, and by placing one end of the diagnostic tube into the depression of the auricle on the left side the familiar oscillating sound of the air entering the middle ear could easily be heard when the air was blown through the catheter. The oscillating sounds were so distinctly heard that I feel sure that he must also have an external bony auditory meatus. In testing his hearing on the left side I found that he could hear the higher pitch tuning fork for a short duration. Bone conduction on that side is increased. He also lateralizes for that side when the tuning fork is placed on the vertex.

"These tests indicate that his deafness is of an obstructive type which may easily be due to closure of the external auditory meatus by skin and cartilage."

The patient's birth had been secured by instrumental delivery, and the ptosis of the left eyelid is attributed to injury at this time. The parents also blame this as the cause of the deformity of the pinna, but in view of the other congenital deformities of the ear it seems more rational to consider the lop ear also a congenital deformity.

The boy was admitted to Dr. Frazier's service at the Episcopal Hospital, and on August 26, 1913, Dr. Ashhurst did the usual operation for lop ear, removing an area of skin from the back of the pinna and from a corresponding surface of the adjoining scalp, and suturing the ear back against the head with interrupted chromic gut sutures. The supernumerary auricular cartilages were also excised from both sides of the head. The result is shown in Fig. 14, from a photograph made a month later.

No operation was done at this time on the external auditory meatus, because the parents did not desire it, and it was not urged because Dr. Eves had not yet made his examination which demonstrated the probable existence of a middle ear.

IMPERFORATE RECTUM.

DR. ASHHURST presented a boy, nearly six years of age, who, on January 14, 1908, being then a baby fourteen days old, was



FIG. 12.

Lop ear, before operation.



FIG. 13.

Congenital occlusion of external auditory meatus.



FIG. 14.

Lop ear, after operation.

brought to the Episcopal Hospital, and admitted to the service of Dr. G. G. Davis. *There had been no bowel movement since birth*; it was said that the urine once was very dark. The baby's abdomen was immensely distended, very tense, shiny red, and covered with many enlarged veins. The family physician had postponed sending the child to the hospital earlier, because a proctodæum was present. This, however, was found to be only three-quarters of an inch deep, ending in a blind pouch. The condition of the child was critical; the abdomen was so dreadfully tense that it seemed almost unsafe to bend the thighs up upon it for fear it would burst. However, the baby was placed on the operating table (lying on a hot water bag) in the lithotomy position. No anæsthetic was given. A median perineal incision was made 4 cm. in length, and deepened through the proctodæum to a depth of about 4 cm. from the skin surface. Here the rectal pouch was found, and incised; at once semisolid fæces squirted out in the form of a goose-quill or slate-pencil. The opening was dilated with forceps, and a large quantity of fæces was evacuated. The bowel (the mucosa of which was inflamed and red) was stitched to the skin with interrupted sutures of chromic gut. No ligatures were needed. The time of the operation was fifteen minutes.

The baby's bowels moved almost continuously for 12 hours after operation. No vomiting occurred after operation, the baby nursed well, and next day the abdomen was soft, not distended, and the redness and shininess had disappeared. Four days after operation the baby and its mother were sent home. Three weeks after operation, when the baby was five weeks old, the mother brought it to see Dr. Ashhurst at the Dispensary; the bowels acted normally, and the general health was excellent.

Nothing further was heard of the baby until he was brought to see Dr. Ashhurst again in September, 1912. He was now four years and a half old, and the complaint was that he had no control of his bowels.

Examination showed the anus and proctodæum as at birth, about half an inch deep, and ending in a blind pouch. Between this and the coccyx was a larger opening, about an inch in length, through which the fæces were passed. The mucocutaneous juncture of this opening appeared normal, but evidently there was no sphincter (Figs. 15 and 16).

Operation, September 30, 1912: Dr. Ashhurst (service of Dr. Frazier, at the Episcopal Hospital). Ether. Patient in Sims's position.

A grooved director was passed into the anal pouch, and was jabbed through into the rectum above (Fig. 15). The septum between the anal pouch and the rectal opening was then slit open,

FIG. 15.

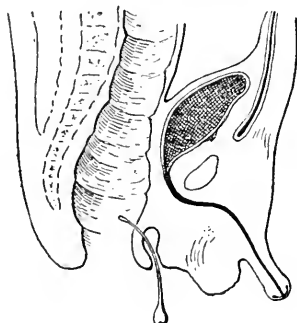
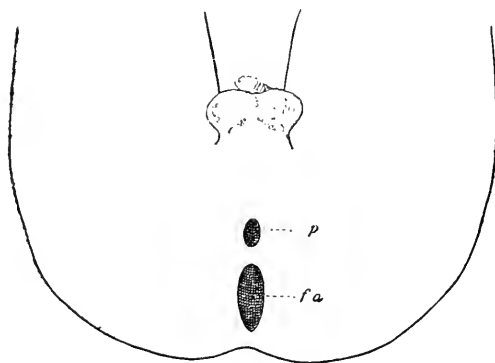


FIG. 16.

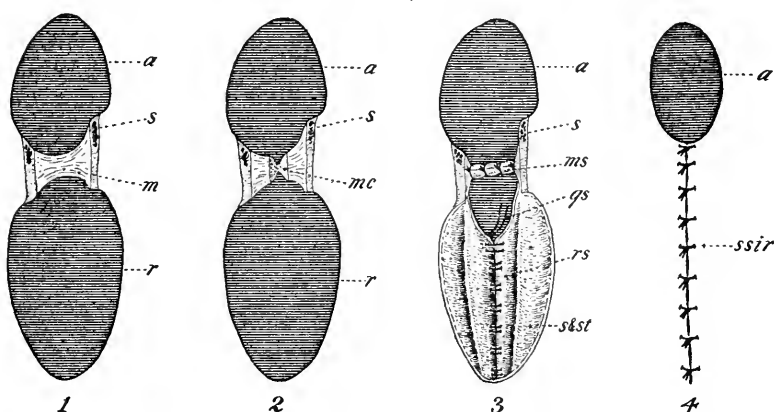


Figs. 15 and 16.—Proctoplasty for imperforate rectum, with secondary operation 4 years later to close a false anus in the perineum. *p*, proctodæum; *fa*, false anus.

on the grooved director as a guide. The fold of mucosa which remained on the anterior rectal wall (Fig. 17) corresponding to the septum between anus and rectum, was then divided in the long axis of the bowel, and was sutured transversely (Fig. 17, 2 and 3), thus restoring the anterior wall of the rectum. Then the rectal wall was dissected free from the skin of the perineum

all around the false anus and as far back as the coccyx, and was inverted toward the median line of the body in two flaps. These flaps were then united in the median line by numerous interrupted quilt sutures of No. 0 chromic catgut, all the knots being placed on the mucous surface of the rectum. This inverted the mucosa well (Fig. 17, 3). Then the ends of the sphincter ani (divided when the septum was slit open at first) were re-united. Next two buried sutures were employed to approximate the levator ani muscles between anus and coccyx; and finally, the skin between anus and coccyx was closed (Fig. 17, 4). A small tube was

FIG. 17.



1, *a*, anus; *s*, sphincter ani; *m*, mucous valve separating proctodæum from rectum; *r*, rectum. 2, *a*, anus; *s*, sphincter ani; *mc*, mucous valve cut; *r*, rectum. 3, *a*, anus; *s*, sphincter ani; *ms*, mucous valve sutured; *qs*, quilt sutures; *rs*, rectum sutured; *s* and *st*, skin and subcutaneous tissues. 4, *a*, anus; *ssir*, skin sutured over inverted rectal wall.

left in the anal opening, to provide for passage of flatus, and if possible to relieve tension on the rectal flaps.

A few of the sutures sloughed out, but good control of the bowel movements was retained, and a finger in the anus detected a strong sphincter. When examined September 20, 1913, one year after operation, the anus was found normal, and perfect control of the bowels had been present ever since leaving the hospital.

EXCISION OF THE ENTIRE TONGUE FOR CARCINOMA.

DR. ASHHURST presented a man, aged fifty-nine years, who was an inveterate smoker. Apart from some trouble with his teeth in November, 1912, he had enjoyed excellent health of

late. One morning in April, 1913, on putting his pipe in his mouth (he always held it on the left side) he felt a burning and smarting sensation in his tongue. On his return to the house he looked in the mirror, and saw what appeared to be a slit on the left margin of the tongue, opposite the molar teeth. After one month he consulted his physician, Dr. H. M. Freas, who put him on mixed treatment, internally, and used iodine solution locally, over the alveolar border and the floor of the mouth, thinking the trouble arose in the teeth. Nevertheless an ulcer formed and increased in size; it was raised above the level of the surrounding tongue, and its margins and base were hard. Finally, about August, it was noticed that the ulcer was spreading up the anterior pillar of the fauces on the left side. Toward the middle of September, Dr. Freas thought some enlargement of the submaxillary lymph-nodes was occurring.

Dr. Freas brought his patient to see Dr. Ashhurst on September 20. The growth had then been noticed for about five months. The patient was a large healthy man weighing about 200 pounds. His blood-pressure was 80-160 mm. There were some albumen and casts in his urine, but the quantity of urine was sufficient, and the heart was normal. A "bronchial" cough had been present for the last forty years.

Examination of the mouth showed that the left border of the tongue from one inch back of the tip to the anterior pillar of the fauces was occupied by a raised, hard, ulcerated tumor, with sharply defined borders, and covered by an ashen gray slough. The mucosa covering the floor of the mouth was invaded, but the ulceration did not extend up on to the alveolus. The anterior pillar was just beginning to be invaded. The ulcer did not extend to the midline of the dorsum of the tongue. The tongue was not fixed. The floor of the mouth (mylohyoid) was not involved. Enlarged lymph-nodes were palpable on the left side at the level of the hyoid bone in the submaxillary region; no other lymph-nodes were palpable anywhere, on either side of the neck. A skiagraph showed no invasion of the mandible.

This was evidently a comparatively early case, as such cases go.

The patient was admitted to the Episcopal Hospital on September 23, and operation was done by Dr. Ashhurst on September 25, 1913, under anæsthesia by intratracheal insufflation of ether,

FIG. 18.



Tongue excised for carcinoma; submaxillary salivary gland and cervical lymph-nodes.

administered by Dr. W. E. Lee and Dr. Billings. Dr. Ashhurst said he would not go into the technic of the operation, as he hoped to bring this subject before the Academy on a future occasion. It sufficed to say that the plan of operation was modelled on Crespi and Bastianelli's modification of Langenbeck's method. The fat and lymphatics and the submaxillary salivary gland on the left side were removed in one mass, from the bifurcation of the carotid artery to the tongue and mastoid (Fig. 18); then the tongue was removed by turning aside the cheek. The neck wound was drained by a tube. The entire operation took two hours.

The patient left the table with a pulse less than 100, and subsequently it never exceeded this rate. There was no post-operative vomiting, and at no time any evidence of pulmonary irritation. The temperature averaged about 99° F., for the first few days, and then reached normal. The patient slept well the night after the operation, with a little paraldehyde, which he *said* tasted pleasant to him. Next morning he was able to make himself understood in talking. He was encouraged to swallow at once, and was able to take liquid nourishment from the first attempt. On the third, fourth and fifth days after operation a little liquid food discharged through the neck wound in swallowing, but this did not recur. He left his bed on the sixth day, and walked out of the hospital on the twelfth day after operation.

Swallowing of solid food was difficult for the first two weeks, but he found that if his mouth was filled absolutely full he could by effort force the mouthful back into the pharynx and so into the œsophagus. Before the end of three weeks he had dined with comfort off pork and beans, and took sauer kraut with relish. He talks with remarkable distinctness, considering the absence of his tongue, and is fairly well understood by the casual interlocutor, while his family never fail to understand what is said.

Pathological Report.—The specimens were examined by Dr. C. Y. White, pathologist to the Episcopal Hospital. He reports:

"The specimen shows a typical epithelioma of the tongue. The epitheliomatous tissue extends from the surface one-half to three-quarters of an inch into the meshes of the tongue. This degree of infiltration would indicate metastasis at least to the draining lymphatic glands. The lymphatic gland in the region of the sublingual salivary gland is free from metastasis. Numerous other microscopical sections,

from the root of the tongue and anterior pillar of the fauces, from the under surface of the tongue, and from the mass of tissue removed from the neck (submaxillary salivary gland, with submaxillary, submental, subparotid, and upper deep cervical lymph-nodes), fail to show any evidence of metastases. Microscopical sections made from the bone removed from the alveolus also are negative for metastasis."

DR. JOHN H. JOPSON said that in his experience the after history of cases of imperforate anus is marked not so much by incontinence as by obstruction from the contraction of the opening which is made to replace the imperforate anus. In one case under observation for between five and six years the condition was such that after three or four years operation was contemplated for the relief of the stenotic condition. In this case the anus was absent and the rectum was found high up; there was no proctodæum and the whole dissection had to be carried out through the perineum. Persistent dilatation was maintained up until a short time ago by means of English catheters and later by conical steel bougies. At one time the boy had distention of the colon as a result of stenosis and a plastic operation for its relief was contemplated, but always just as they would decide on this procedure he would improve and get all right; from last accounts he was in splendid health.

A short time ago he saw a child on whom he had operated eighteen months previously, the patient having been lost track of in the interim. At this visit the child was suffering from constipation, and he found here that there was a tendency to contraction of the septum which he had divided above the proctodæum, and he had to order dilatation in this case as well.

DR. EDWARD B. HODGE mentioned a case seen a few weeks ago, at three and a half years of age, on whom a colostomy had been done two days after birth by Dr. Warren Walker. In the paper he referred to Dr. Ashhurst brought out the fact that few colostomy patients lived to grow up and have the second operation, but this was a patient who did live and who was fairly well nourished. The child came into the Children's Hospital for the establishment of a rectum. Here also was a proctodæum.

The rectal pouch was easily reached at a depth of $1\frac{1}{2}$ inches, brought down and fastened to the skin with the addition of plastic work to secure a sphincter. So far the result has not been tested, as the colostomy opening has not yet been closed.

DR. JOHN H. GIBBON said that in his opinion the operation is

easier when done from below in cases of imperforate rectum because a dilated rectum is more easily found than after a colostomy has pulled it up and contracted it. He thought, however, it would be a mistake in these cases to try to do a plastic operation in the beginning; what Dr. Ashhurst did first, although only producing temporary relief, is the proper procedure.

One case of his own, operated on at the Pennsylvania Hospital later, came into the Jefferson Hospital with a very tight opening through which very little could pass and he found the rectum filled with densely hard enteroliths which bounced on the floor like marbles when removed with a scoop. He did a plastic but had to dilate the opening from time to time; the child now has perfect control.

INTUSSUSCEPTION.

DR. FRANCIS O. ALLEN gave a Review of Twenty-seven Cases of Intussusception at the Children's Hospital. For this paper see page 258.

DR. GEORGE G. ROSS said that he had seen three cases of intussusception. Two of these were in adults, the other in a young child about 22 months of age. The first adult case was one in which an intussusception occurred during convalescence from typhoid fever, giving rise to symptoms simulating those of perforation. On opening the abdomen an intussusception was found high up in the jejunum. It had occurred only a few hours previously, it was easily reduced, and the abdomen closed; the patient recovered. The second case was a man who had eaten deviled crab which was bad, he was taken violently ill that night; the following morning he had a violent pain in his abdomen and the doctor concluded he had obstruction of the bowel and hurried him to the hospital. He had an enterocolic intussusception which was tightly fixed, the ring about the intussusception was gangrenous, and the condition required an ileocolostomy. In addition to the distention from the obstruction there was a distention from the food poisoning, but the patient died. In the baby the condition came on without apparent exciting cause. He was crawling over the floor when he suddenly grabbed his abdomen and howled with pain. The diagnosis of intussusception had been made by the family doctor in the country. The child's abdomen was opened, an ileocolic intussusception was found, easily reduced and

stayed reduced, but during the trip to the hospital the child developed a cold and died 18 days after operation from pneumonia.

He was interested in the theory of intussusception causing the Jackson membranes or Lane's kink adhesions. He had felt that the vast majority of these conditions were acquired and that they must be due to some low grade inflammation of the peritoneum. Just what the most common cause is he had not been able to find out; although he had felt for some time that the appendix was responsible for a great many of them. A localized peritonitis of low grade without perforation of the appendix would seem a plausible explanation. He could understand how an intussusception which has been reduced and which stays reduced may produce a slow forming adhesion, the result of a low grade of localized peritonitis.

DR. WALTER ESTELL LEE said that in the sixth case reported he was the operator, and he could corroborate Dr. Allen's feeling that many of these intussusceptions relieve themselves. This child was seen by Dr. Howard Carpenter three days before operation, with symptoms of acute obstruction, and he advised it being sent to hospital but the parents refused. The next morning the child seemed perfectly well, the bowels moved normally and continued to do so for 48 hours, then the previous symptoms suddenly recurred and the child was brought to the hospital. At the operation the intussusception was very easily overcome, with the slightest traction the bowel was restored, and it was then sutured to the parietal peritoneum.

INJURIES TO THE ACROMION PROCESS.

BERNHARD MENCKE (by invitation) presented a paper with the above title for which see page 233.

DR. T. TURNER THOMAS said that if there is one thing about injuries to the shoulder that he would be glad to aid in establishing it is the importance of hyperabduction. It is to the shoulder what the twist of the foot is to the ankle. The great mass of injuries in the ankle region are due in the main to the turning of the foot inward or outward. That is not so obvious in connection with hyperabduction of the shoulder because the limb practically never remains in the position to which it is forced because gravity draws it down again.

If the arm is carried into abduction it is resisted first by the

capsule, that is the capsule offers the inelastic resistance and gives way first because it is to the skeleton at the shoulder what the bone is to the skeleton between the joints. In adults it is weaker than the bones, in children it is stronger, as shown by the relative frequency of dislocations of the shoulder and fractures of the clavicle in adults and children. When the arm goes into abduction the capsule binds and turns the scapula outward; it reaches a point where it cannot go further and when abduction is carried beyond that point something breaks and it is the capsule in the great majority of cases. When it tears it constitutes a break in the skeleton at the joint which means either a sprain or a dislocation, the sprain being a tear or break in the skeleton at the joint without displacement, and dislocation with displacement. In most cases the capsule tears. It is after the capsule tears that this contact takes place, that is the leverage and fulcrum effect from the contact of the humerus with the acromion, and it is right there occurs the crucial movement in these injuries to the shoulder region.

Hyperabduction is responsible not only for dislocations of the shoulder, but perhaps also for other conditions such as fracture of the surgical neck or a break in the lever at the fulcrum, fracture of the acromion, or a break in the fulcrum, and the upward dislocation of the outer end of the clavicle, the articulating surface of which favors the forcing inward, by the lever, of the acromion under the clavicle. Nothing is more difficult to prove than the actual mechanism of injuries to the skeleton.

MODERN LABORATORY METHODS IN THE DIAGNOSIS OF SURGICAL DISEASES OF THE GENITO-URINARY TRACT.

DR. A. T. GAILLARD (by invitation) presented a paper dealing with the above title for which see page 267.

DR. B. A. THOMAS said that he was not as enthusiastic as Dr. Gaillard over the value of the microscope in diagnosis of diseases of the genito-urinary tract, although giving it due credit for its great worth. Other procedures can aid in the diagnosis, and many of them are of more value than is the microscope alone. Dr. Gaillard said the radiogram left in doubt about 75 per cent. of diagnoses of calculus of the kidney, and that 50 to 75 per cent. are due to uric acid. It had been his experience that radiography will definitely determine renal or ureteral calculi, if present, in

at least 95 per cent. of cases, and we have never yet, with the best radiogram obtainable, found it impossible to make a correct diagnosis of stone in the kidney or ureter. In the case of a very soft urate, assuredly, the skiagram might not show the lesion. In his opinion the skiagram is the measure of greatest value in diagnosis of calculus of the kidney or ureter. Moreover, he could not see that urinalysis alone will diagnose the lesion so far as calculus is concerned, whether of the kidney parenchyma or of the pelvis or ureter when judged from the cytology; it may suffice to locate the inflammatory site, but does not specify that the real lesion is calculus. The cystoscope cannot be superseded by cytological examination in the diagnosis of many of these conditions, particularly in lesions of the bladder, where it is better for the patient to make a definite diagnosis by the cystoscope than to subject him to the lengthy process and uncertainty of repeated urinary examinations. Then again with all due respect to cytology of the urine, it is impossible except by making serial sections of certain tumors of the bladder to tell whether the condition is benign or malignant, because true malignancy may depend upon the disintegration of the base of the tumor, that is, whether or not the basement membrane has been broken through and the underlying tissues infiltrated by the proliferating epithelial degeneration.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

*Stated meeting, held at the New York Academy of Medicine,
November 12, 1913.*

The President, DR. FREDERIC KAMMERER, in the Chair.

FRACTURE OF THE SCAPULA.

DR. JAMES M. HITZROT presented two young men, each of whom had sustained a fracture of the scapula, one in attempting to stop a runaway horse, the other in a fall from a truck. In the first case, the X-ray showed a fracture through the neck of the scapula. The characteristic deformity usually described in connection with this form of fracture was absent, and there was practically no loss of function. No effort at reduction had been made.

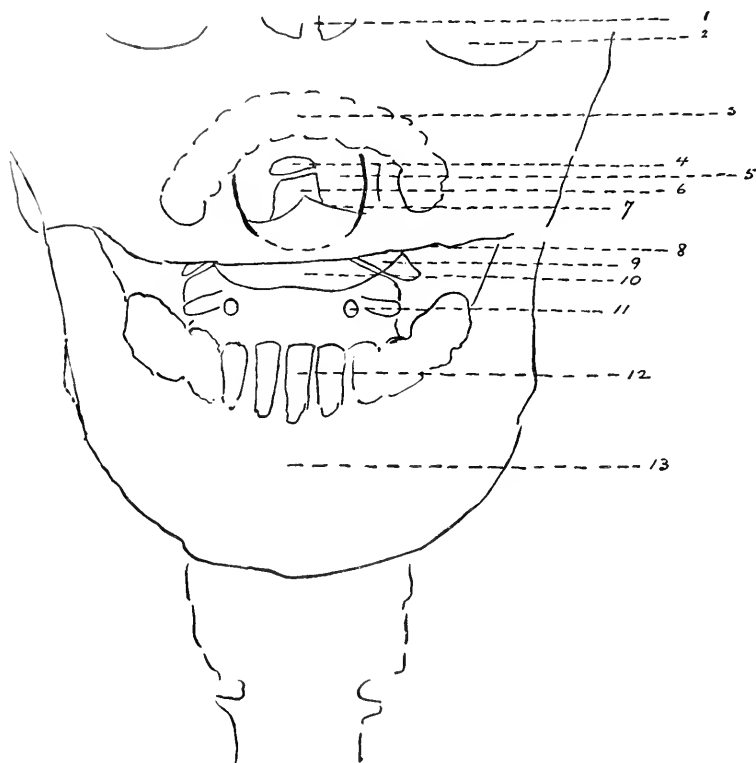
In the second case, the fracture was through the lower facet of the bone, and the lower two-thirds of the articular surface had been carried downward and inward, producing loss of function. The clinical features of this case were fairly characteristic, and there was a marked difference between the two shoulders.

FRACTURE OF THE ODONTOID PROCESS OF THE AXIS.

DR. OTTO G. T. KILIANI presented a man (and the X-ray plate) who was riding to hounds eight weeks ago, when his horse, a heavy English hunter, stepped into a deep, narrow ditch, and in endeavoring to recover itself, threw its head back, striking the rider in the face and breaking his nose. He was stunned, and pitched forward, falling to the ground upon his face. A short period of unconsciousness followed, no vomiting; after two days' rest, he attended to his usual duties. When Dr. Kiliani saw him, about ten days later, the only symptom he complained of was

inability to raise his head while lying down. No pain on rotation, some pain on flexion to either side, and on flexion backward. An X-ray was taken through the open mouth, which clearly revealed a fracture of the odontoid process of the axis, the top of the process being broken off.

FIG. 1.



Tracing of X-ray plate taken by Dr. W. H. Stewart, visiting radiologist of the German Hospital. Photograph taken with the mouth open, the patient in a recumbent position, with the occiput on the plate. 1, anterior nasal spine; 2, orbit; 3, upper teeth; 4, fragment; 5, foramen magnum; 6, odontoid process; 7, internal occipital crest; 8, lower line of base of skull; 9, transverse process of atlas; 10, anterior arch of atlas; 11, intervertebral foramen; 12, lower teeth; 13, lower jaw.

Dr. Kiliani said that a rather careful search of the literature showed that this form of fracture had either gone unrecognized, or was extremely rare. In most of the cases reported, the fracture was through the neck of the process, lower down than in this case. Dislocations of the axis, of course, were comparatively frequent. As to the explanation of the fracture in this instance,

one could only surmise that it was possibly the result of a sudden, forcible flexion of the head backward, or that the fragment had been torn off by its ligamentous attachments.

EXPERIMENTAL INTESTINAL OBSTRUCTION.

DR. JOHN A. HARTWELL presented a dog to illustrate the results of some experimental work that had been done by Dr. J. P. Hoguet and himself bearing upon the subject of intestinal obstruction, the object being to find out the direct cause of death in this condition. The dog had been operated upon twelve days previously, when the bowel was sectioned at the lower end of the duodenum and the two ends closed by inversion, thus producing a complete obstruction. The amount of urine and vomitus put out was measured, and the dog received, subcutaneously, normal saline solution in amount slightly in excess of this. During the first four days of the experiment the output was approximately 450 c.c. per day, which was exactly one-twentieth of the body weight. After the sixth day the vomiting ceased and the stomach tube recovered nothing. The amount of urine, however, increased, and corresponded closely to the amount of saline given. The animal was in perfect condition except for loss of weight, due to lack of food.

Dr. Hartwell stated that in this way they had been able to keep dogs in a healthful condition as long as twenty-six days, which was the longest they had continued their observation, but under this treatment no animal in a series of ten had died. On killing these animals, examination of the organs showed a normal liver, kidney and spleen, the only lesion found being a dilatation of the intestine and stomach above the obstruction. Dogs so operated, who did not receive the salt solution, lived never more than ten days, and usually died in five or six. Autopsy in these cases showed a very marked granular degeneration of the kidney and liver, with sometimes actual necrosis of the latter. A comparison of the urine in the treated and untreated dogs showed that of the former to be absolutely normal, while that of the latter contained albumin in excess, two to three times the normal output of nitrogen, and a marked disturbance in the creatin creatinin ratio. These findings demonstrate conclusively a very marked destruction of tissues, which is accounted for by the abstraction of water. Dogs with a low intestinal obstruction behave in exactly

the same way, with one important difference. In case the over-distention of the bowel above the obstruction becomes so great that the circulation is seriously disturbed, with a resulting damage to the mucosa either in the way of ulceration or necrosis, the dogs cannot be kept alive by the administration of the salt solution.

Dr. Hartwell said that further experimentation they had done confirmed this finding; the damage to the mucosa introduced a new factor into the situation, and that when this was present, saline solution would not save life. The experiment, therefore, demonstrated that the cause of death depends upon two factors. First, the loss of water from the tissues, and second, the damage to the intestinal mucosa, from which, apparently, poisons were absorbed, this being the only source of actual poisoning. Though no direct evidence was obtained, microscopical examination of the damaged mucosa indicated that the poison arose from an infectious process in the damaged mucosa.

Dr. Hartwell said that a clinical application of these findings had been made in two cases of intestinal obstruction, who had absorbed 7000 c.c. of salt solution, administered subcutaneously, during the first thirty-six hours following the operation.

Further, it would seem advisable to empty the bowel above the obstructed point when the obstruction had persisted long enough to result in damage to the mucosa, and if the damage was extensive, an enterostomy probably would be of benefit in order to maintain drainage for a few days.

JEJUNAL ULCER FOLLOWING GASTRO-ENTEROSTOMY FOR DUODENAL ULCER.

DR. HARTWELL presented a man, thirty-three years old, who was admitted to Bellevue Hospital in June, 1907, with the following history: He was a truckman, working very hard, and drinking both beer and whiskey to excess. There was no record of any previous illness. His present illness dated back about one year, during which time he had three attacks of acute abdominal pain in the right lower quadrant of the abdomen. The suddenness and severity of these attacks is witnessed by the fact that he has been seized with them when at work or walking, and has been suddenly incapacitated by the intense cramp-like pain in this region. He has usually vomited at the time of the onset. The pain had lasted severely only for a short time, but he has re-

mained in bed from two to ten days. He was just recovering from an attack on his admission to the hospital. Examination that time showed slight tenderness and rigidity in the appendix region; nothing else. There was no elevation in temperature. An appendectomy was done, and a slightly inflamed appendix was removed.

Following this operation he was entirely free from symptoms until November, 1909, when he had another very acute attack of abdominal pain which made him fall to the ground. It was accompanied by vomiting and great prostration. He was immediately taken to Bellevue Hospital, where an operation was done for an acute perforation of a pyloric ulcer. The ulcer, which was on the anterior wall, was closed with purse-string suture, and a posterior gastro-enterostomy with short loop by means of the Murphy button was done. His recovery from this operation was completely satisfactory and he remained in good health until May, 1913. He then again began to suffer moderate abdominal pain, this time mostly in the epigastrium, sometimes accompanied by vomiting. The pain usually began in the morning, shortly after breakfast, and continued throughout the day, irrespective of meals, but relieved by vomiting. Blood was noticed in the vomitus only once, and there was no record of his having passed any by stool. After three or four weeks of this condition he came to the hospital and was operated upon by another surgeon. The gastric artery, with the nerves surrounding it, was doubly ligated; the object being to modify the secretion of hydrochloric acid. Some relief was obtained following this operation, but in a few months the symptoms recurred exactly as before. He was readmitted to the hospital early in October, 1913. Examination at that time showed him to be in good condition, well nourished, and suffering only from a recurrence of his previous symptoms. There was a ventral hernia at the site of the previous operations. No points of tenderness were present, and no masses could be felt. A bismuth X-ray showed that the stomach emptied itself rather promptly and that both the pylorus and the gastro-enterostomy were open. Gastric analysis after a test meal showed a total acidity of 60; combined acidity 48; free HCl 40. No lactic acid; no blood; many starch granules and undigested food particles. The aspirated material was bright green in color, which was found to be due to the presence of bile pigments.

Operation was performed by Dr. Hartwell on October 10, 1913, through a median incision in the epigastrium. On opening the peritoneum, rather extensive adhesions were found between the great omentum, the pylorus and the gastro-enterostomy stoma. On freeing these adhesions, the scar of the old ulcer on the pylorus close to the gastric side of the pyloric vein was palpable. The pylorus readily admitted the index finger on invaginating the stomach through it. The stomach itself was moderately dilated. The gastro-enterostomy opening easily admitted two fingers. The jejunum on its anterior surface, immediately distal to the anastomosis, was adherent to the wall of the stomach about one and one-half inches from the line of union. On separating the adhesion, which was comparatively recent, a perforation was found in the jejunum about three-eighths of an inch from the anastomosis. The ulcer, of which the perforation was the centre, was excised, together with the line of anastomosis adjacent to it. The opening into the two viscera thus made was closed by the usual suture method, re-establishing the stoma. Convalescence following this operation was satisfactory, and the patient has been entirely free from any symptoms. His diet, which has been somewhat limited, has been taken without discomfort or nausea.

A gastric analysis, made on November 5, shows a total acidity of 50; combined acidity, 15; free hydrochloric acid, 12. No lactic acid; no blood nor bile.

Dr. Hartwell said this case was presented to emphasize several facts: First, that the patient's original symptoms were probably due to the pyloric ulcer, but were relieved by the appendectomy. Unfortunately, no gastric analyses were made at that time. His entire freedom from pain from this time up to the acute perforation two years later is unusual considering the fact that he had previously suffered from attacks of severe pain. The fact that bile was found in considerable quantities in his gastric contents before the last operation is worthy of note, in view of the belief that these marginal ulcers occurring around the gastro-enterostomy stoma are in part caused by the passage of unneutralized hydrochloric acid over a mucosa that normally is not subject to this irritation. The fact that so many of these ulcers occur at or near the stoma makes it seem probable that the operative trauma is an etiological factor. For this reason, the writer has of late discarded the use of the clamps in this operation, and

followed the method of Coffey, in which the soiling of the abdomen is prevented by elevation of the stomach and jejunum by the use of traction sutures.

The case is also presented as one more illustration of the fact which we all recognize, namely, that surgical means are at best but an aid toward the cure of gastric and duodenal ulcers. This patient has admittedly been as careless in his diet and in the use of alcohol during the past three years as he was previous to his original trouble. This factor probably has an important bearing on the recurrence of his symptoms.

DR. ROBERT T. MORRIS said that in one case where he excised a jejunal ulcer there was a recurrence about a year later. The patient died from inanition, and at the autopsy a second ulcer was found about two inches below the primary one. If these ulcers were due to the highly acid character of the stomach contents bathing the newly exposed mucosa, we may fairly assume that its irritating effect is exerted in causing proliferating endarteritis over the areas of distribution of some of the terminal arteries, resulting in a localized anæmia and the formation of ulcer. When this process was under way, it seemed to call out a general or local leucocytosis which acted as a protection against further involvement of the other terminal arteries in the vicinity. The above, at least, Dr. Morris said, was a working hypothesis.

ARTERIOVENOUS ANASTOMOSIS FOR THROMBO-ANGELITIS OBLITERANS.

DR. HOWARD LILIENTHAL presented a man, forty-four years old, married, a Russian by birth, who was admitted to the Mt. Sinai Hospital on March 1, 1913, with the history that his illness began eighteen months prior to that time with the appearance of painful red streaks on the legs and knees, the discoloration migrating down to the feet. Eight weeks before his admission, painful swelling of the right foot developed, and three weeks later a physician had incised the right great toe without evacuating any pus and without relief from the pain. The wound failed to heal and had become gangrenous and excruciatingly painful.

On admission, there was no pulsation in either foot, and both feet and legs were mottled in appearance. There was frank gangrene of the right great toe.

After the disease and its prognosis were explained to the

patient, together with the possible necessity for amputation, he consented to an arteriovenous anastomosis, which Dr. Lilienthal performed on March 10, 1913. Through an incision from the groin to the mid-thigh he made the anastomosis in Hunter's canal, employing the method of Carrel, closing off by ligature the continuation of the artery below and of the vein above. In the event of failure it was believed that some circulation might be carried on through the vessels given off above the arterial section.

As soon as the suture was completed and the clamps removed, the vein filled, and a small tributary just below the level of the union spurting arterial blood and had to be ligated. The only change in the foot was the appearance of a patch of pallor about the gangrenous area. The wound was closed with deep catgut sutures and a superficial layer of silk. On the following day the patient's temperature rose to 101° F., but there was no change in the appearance of the foot. On the second day, however, it had a better color than its fellow, but there was no relief of the pain and no venous pulsation had appeared. A month later there was great improvement, all the œdema having subsided and the skin had resumed its natural color.

In spite of a negative Wassermann reaction, salvarsan had been administered, but the pain in the toe was so severe and persistent that it was amputated on April 11. At this operation there was considerable bleeding from spurting vessels, something which the speaker said he had never before observed during an amputation for this condition.

Since the patient's discharge from the hospital, about six months later, there had been gradual but certain improvement. The wound in the foot healed slowly, and even at the present time there was a minute spot where the skin previously healed had been rubbed off. The general appearance of the foot, however, was quite normal, and there was no more pain, which he regarded as one of the most important criteria of the success of the operation.

DR. LILIENTHAL presented a second case of arteriovenous anastomosis for thrombo-angeitis obliterans, in the person of a man, fifty-four years old, who was admitted to the Mt. Sinai Hospital on March 22, 1913, with the story that four months before that date he had applied a solution of carbolic acid to his left foot, and that as a result there had appeared a spot of gangrene

upon one toe. On admission, he complained of pain principally in the middle toe of the left foot, and there was here a darkening of the skin, with some necrosis of the soft parts. Neither popliteal artery could be felt, and there was no dorsalis pedis pulsation in either foot. The middle toe of the left foot showed skin necrosis extending from the nail for a distance of one and a half centimetres upon the plantar surface. This region was extremely tender to the touch and very painful.

On admission, the patient's temperature was 99.2° ; pulse, 92; respirations, 28. His general condition was good. The left foot, in addition to the lesion on the middle toe, was slightly dusky, and there was a trace of œdema upon the dorsum. The Wassermann blood test was negative.

On March 24, 1913, under ether, an incision was made from the highest point over the femoral vessel down to the level of the lower portion of Hunter's canal. The vessels were carefully dissected out, and a temporary ligature was placed upon the vein at a point about one centimetre from its entrance to Hunter's canal. This ligature was merely crossed and held with an artery forceps, and was placed in such a way that it embraced a large tributary, as well as the vein itself. The upper portion of the vein was then permanently ligated and a section made below the ligature, a considerable distance above a large valve. The blood was washed out of the lumen of the vessel with Ringer's solution. The femoral artery was now freed, and a ligature passed around it as far below the section of the vein as possible. Just before this ligature was tightened, however, the forceps holding the femoral vein ligature slipped, and there was a sudden and most annoying hemorrhage. Although the actual loss of blood was not great, the conditions were rendered so unpromising that he was almost induced to abandon the operation and simply ligate the vein. However, the vessel having been secured with the fingers, and the large tributary having been permanently ligated, it was decided to proceed with the operation. A serrafine now took the place of the ligature, the artery was permanently ligated, and while it was controlled from above with two serrafines, section was made just above the ligature. There was considerable slack owing to the extra length of the artery, but thinking that the operation would thus be rendered easier, this slack was not cut away. An arteriovenous anastomosis was now completed by Carrel's method, using No. 13

needles and thread six O. The anastomosis was rendered somewhat difficult because of the great disparity in size between the small femoral artery and the unusually large femoral vein. When the suture was completed and the clamps removed, the vein immediately filled out, and on manipulating the vessel there was a spurt of blood, showing a leak at the line of suture. Two extra sutures were inserted and the clamps were again removed. There was now no leakage, but on moving the vein and artery so as to angulate the line of anastomosis, blood again showed. This, however, stopped spontaneously, nor could it again be made to flow without the use of undue and dangerous manipulation. Feeling a bit uncertain, however, as to the exact condition of the anastomosis, a ligature of chromicized catgut was passed around the femoral vein and another loosely about the femoral artery, and the wound was then closed completely, without drainage, the long ends of the chromicized gut being buried by the cutaneous suture. This was done so that in case of accidental hemorrhage, the house surgeon might easily remove the skin sutures and find the ends of the chromicized gut ligatures ready for tightening. The necessity for this, fortunately, did not arise.

Immediately after the operation the affected foot looked slightly more cyanotic than its fellow. Eighteen hours later the color of the foot was excellent, with an apparently good capillary circulation. The patient had suffered no shock nor severe pain.

Dr. Lilienthal said this was the second case of localized gangrene of the foot in which the condition was ascribed to the use of a carbolic acid lotion. Personally, he did not believe that the use of the carbolic acid had anything to do with it. The speaker said he was naturally interested in the outcome of this operation, as he was the first one to perform it in this way, although he had been anticipated by Hubbard who used another operative method. The exact relation of the operation to the cure was very questionable, in his mind. He had been informed that in these cases relief would follow simple ligation of the vein, but he preferred to do an arteriovenous anastomosis, in spite of the fact that the results were not very convincing to him, as he had never been able to get any venous pulsation excepting on the operating table. Still, the fact that he had been compelled to tie spurting vessels after this operation indicated an arterial circulation, and he

could not recall any case of amputation for gangrene resulting from thrombo-angitis obliterans in which he had found it necessary to ligate a vessel unless the amputation was done very high up—certainly never before during an amputation of the toe, as in the first case shown. Whether the benefit derived by these patients resulted from an obliteration of the vein by thrombosis, or whether there was an actually functioning arteriovenous anastomosis he did not know. He felt assured, however, that both of these patients would have been subjected to an amputation of the foot but for this operation.

DR. C. A. McWILLIAMS said that at one of the meetings of this Society last spring he showed a patient upon whom he had done an anastomosis between the femoral artery and vein by the Bernheim method, which he thought was preferable to the end-to-end method because there was less liability of subsequent interference with the arterial circulation. In that case, antedating the operation, the patient had suffered from a gangrenous toe, and after some hesitation, Dr. McWilliams said he amputated the toe and the wound healed very nicely, with the exception of a small sinus. The patient was markedly relieved of his pain.

One added advantage of such an anastomosis in this condition, the speaker said was that in case amputation subsequently became imperative it could be done lower down than otherwise.

DR. EDWARD M. FOOTE said that in his experience with these cases, the pain had varied greatly at different times. In one case in which during a period of eight years he had found it necessary to amputate fragments from all four extremities the pain had been very severe at times, while at other times it was comparatively trifling. As some of these patients are worse in the winter, he had rather held the idea that cold weather was an important factor in the causation of this condition; but recently he had a patient from San Domingo with typical well advanced lesions.

DR. LILIENTHAL, in closing, said he had never seen any satisfactory explanation for this condition. He was not inclined to attribute it to cold weather, nor would that explain why it was practically confined to men, and to young men as a rule. In all of his cases, the patients were addicted to the excessive use of cigarettes.

The speaker said he had seldom found a thigh amputation necessary in these cases. He usually amputated according to the

condition of the vessels, and he would not go as high as the thigh unless it was absolutely indicated. He had repeatedly used Dr. Moschcowitz's modification of Bier's method and done an osteoplastic amputation, with very good bone nutrition. An operation in these cases should not be looked upon as a cure, but simply as a relief measure. There was no cure for these patients.

As to the matter of ligating the vein, some authority—Coenen, he believed—claimed that relief was obtained in that way by keeping more blood in the affected parts. However, after the production of Bier's hyperæmia in these cases, some of the patients complained bitterly of pain. As to the side-to-side method of anastomosis, which Dr. McWilliams preferred, the speaker said he did not approve of it unless we admitted that we were simply accomplishing a ligation of the vein, because he was fairly certain that with this method of anastomosis there was a strong tendency to the production of a saddle thrombosis.

MIXED TUMOR OF THE PAROTID GLAND, WITH MALIGNANT DEGENERATION.

The President, DR. F. KAMMERER, showed a woman of forty-eight years upon whom he had operated for a mixed tumor of the parotid gland, with malignant degeneration, in July, 1913. The patient had noticed a slowly growing tumor below the left ear for the past 3 or 4 years. During the past six months it had increased very rapidly in size, until, at the time of her admission to the hospital, it presented the appearance shown in the accompanying photograph. (Fig. 2.) An elliptical incision was made over the tumor and extended downward to expose the external carotid artery, which was ligated with some difficulty. The extirpation of the growth was accomplished without much hemorrhage. The tumor had entirely eroded the zygomatic arch. The ramus of the lower jaw near the angle had to be removed, with the exception of a small ridge which preserved the continuity of the bone. The buccal cavity was not opened. There was apparently no involvement of any of the lymphatic glands. The facial nerve was naturally divided during the operation. The patient made an uninterrupted recovery, and up to the present time there had been no recurrence. The microscopic diagnosis was carcinoma.

FIG. 2.



Mixed tumor of the parotid gland. (Kammerer.)

The speaker referred to a similar case of carcinomatous degeneration of a mixed tumor of the parotid, not quite as large as the one shown this evening, which he had operated on four years ago. In that case there was no local recurrence, but the patient died 3½ years later of what seemed to have been metastatic deposits in the liver.

In connection with these two cases, Dr. Kammerer had hoped to show a third case of a large parotid tumor, which he had operated on eight years ago, a young woman who was in perfect health at present. In this case, although an operation was done for a second recurrence, the growth showed no malignant degeneration.

In mixed tumors of the parotid or submaxillary gland, which have very gradually increased in size, it was certainly the proper surgical procedure to enucleate them from the investing capsule, leaving the salivary gland intact. For such cases simple enucleation should lead to a permanent cure. The speaker, however, thought that after one or two recurrences it was advisable to do a radical operation, removing the entire gland, even at the cost of the facial nerve, in tumors of the parotid, more especially as statistics seemed to show that the repeated traumatism of operative interference was a decided factor in the conversion of mixed tumors to the malignant type.

ABSCESS OF THE LUNG: INCISION AND DRAINAGE: THORACOTOMY.

DR. LILIENTHAL presented a boy, thirteen years old, who was admitted to the Childrens' Service of Mt. Sinai Hospital late in December, 1912, where for some time he was under the observation of Dr. Henry Koplik. The history obtained was that he had a left-sided pneumonia in infancy and that his tonsils and adenoids had been removed a year and a half ago. It was said that he had a second attack of pneumonia a few months ago, and following this he suffered from chronic cough and an occasional hæmoptysis. About two weeks before his admission his cough became worse; he was feverish, complained of pain in the chest and was easily tired.

A physical examination showed dulness over the left supra-

spinous fossa extending to one finger below the spine of the scapula. There was also marked dulness anteriorly over the left side and the upper part of the left axilla, with bronchial voice and breathing over these areas. There were some subcrepitant râles over the left supraspinous region, with bronchovesicular breathing over the left interscapular region. The breathing sounds were much diminished over the left base, together with impaired resonance. A blood count showed 15,000 white cells, with 54 per cent. of polynuclears. The von Pirquet test was negative, and no tubercle bacilli were found in the sputum.

On December 21, 1912, pus was obtained on aspirating in the left axilla, the needle being carried upward and backward. About two weeks later the boy was anesthetized, and an incision was made from the clavicle downward, dividing the fibres of the pectoralis major, which were then bluntly separated and the second rib exposed. A section of this rib, about three-quarters of an inch long, was removed, and upon aspiration, foul pus was again withdrawn. Upon enlarging this opening with a grooved director and dressing forceps, it was noted that in passing through the abscess cavity the tissues were extremely hard—almost cartilaginous. About three drachms of thick foul pus were evacuated. A tube was then inserted and the wound packed. Prior to this operation, the X-ray had shown a diffuse opacity of the left chest, but nothing like a lung abscess could be made out. At the time of the operation, beneath the thick-walled abscess, apparently normal pleura could be seen moving with respiration. The general pleural cavity, however, was not entered, as the case was apparently one of lung abscess connecting with the bronchus. Dr. Koplik did not agree with this diagnosis, regarding the case as one of apical empyema.

On January 7, 1913, the tube was removed, a strip of tape impregnated with bismuth was packed into the wound, and a stereoscopic X-ray picture taken in the hope of demonstrating the exact location of the lung abscess. Owing to the rather diffuse area of opacity of this entire region of the chest, however, the subsequent picture proved little excepting that the cavity was nearer the posterior than the anterior wall of the chest. The case progressed favorably for about ten days, when the patient again became feverish and complained of considerable pain in the wound. Under nitrous oxide anesthesia the drainage

opening was stretched so as to permit of digital exploration. Nothing of note was found, and aspiration practised in various directions upward gave negative results. There was still considerable cough and expectoration.

On January 25 the wound in the chest wall had filled up and showed a strong tendency to heal. The cough and expectoration, however, persisted, with occasional rises of temperature. Flatness in the upper, posterior part of the chest extending to the axillary region caused Dr. Koplik to suspect the presence of fluid, probably pus, and under a general anæsthetic the chest wall was again aspirated, the needle being passed through the upper portion of the axilla, pointing upward and backward. Although a large sized needle was used, no pus was obtained at this puncture. At one attempt, pure blood was withdrawn, perhaps a drachm, before the suction was checked. The anterior wound was now explored with the finger, but only the original cavity was found. A needle inserted here and passed through the posterior wall of this cavity withdrew a few drops of extremely thick pus. A dressing forceps following the needle was pushed through until the points were palpable underneath the skin just above the scapula. Here a counter incision was made and a drainage tube of considerable size was drawn through from the back to the front.

Following this operation, the boy's condition gradually improved. The fever and the quantity of the expectoration varied from day to day, but gradually diminished until the drainage tube was removed, the sinus being kept open by a large-sized triple silk ligature. When this was withdrawn, on March 5, the patient still had a pallid, sick appearance, although his nutrition had improved. Upon the withdrawal of the silk, the cavity was injected with iodoform sesame oil and spermaceti (Mosetig-Moorhof filling), and for a long time after this was done the patient complained of the taste of the iodoform. The wound was now nearly healed and the general improvement continued, though cough was still present.

The patient left the hospital on April 25, 1913, and was subsequently sent to a convalescent home, where he remained for some time and his health steadily improved. His condition at the present time was excellent.

POST-OPERATIVE INTESTINAL OBSTRUCTION: ENTERO-ENTEROSTOMY.

DR. EUGENE H. POOL presented a man, twenty-four years old, who was admitted to the New York Hospital on July 8, 1913, with the history that for three weeks prior to his admission he had been confined to bed with an attack of appendicitis. Examination revealed a tender mass, about 2 x 3 inches, in the right lower quadrant. The patient was operated on and an appendiceal abscess was opened and drained. The patient did well until the fourteenth day after the operation, when he complained of pain in the abdomen, with frequent retching and vomiting, and later hiccoughs. He was given a high enema, which was fairly effectual, but his symptoms continued throughout the night and the following day. Upon washing the stomach, which was done three times, a greenish fluid was recovered. Repeated enemata and colon irrigations at first brought away a small amount of gas, finally neither gas nor fæces. On the morning of the sixteenth day after operation (48 hours after the onset of the symptoms) the patient was vomiting at frequent intervals small amounts of dark-colored fluid, and was hiccoughing. There was absolute obstipation. While there was no general abdominal distention, visible peristalsis was noted in the upper abdomen.

The abdomen was opened to the right of the midline above the umbilicus; the right upper quadrant and appendical regions presented a mass of firmly adherent intestines. A greatly distended loop of intestine was visible; likewise collapsed loops of small intestine. Three distinct deep-lying bands of adhesions were freed, but in spite of this the bowel remained collapsed, and as it seemed unwise to further prolong the search, a lateral anastomosis with suture was made between the collapsed and distended loops close to the adherent mass. The patient vomited only once after the operation and his immediate recovery was uneventful. Fourteen days after the anastomosis, however, he again complained of pain in the abdomen and vomited a large amount of fluid. The symptoms then temporarily subsided, but five days later they recurred with increasing severity, with every evidence of complete high intestinal obstruction. The abdomen was again opened, this time to the left of the midline above the umbilicus, revealing a condition similar to that found at the preceding operation, excepting that the adhesions were even

more extensive. The previous anastomosis was found surrounded by adhesions. There was a short section of greatly distended bowel, showing that the obstruction was high in the small intestine; a second anastomosis was made between this and the collapsed bowel, a short distance from the adherent mass. The wound was closed without drainage, and the patient made a good recovery. With the exception of occasional attacks of colicky pain, he was now in good health and his bowels moved regularly without the aid of cathartics, upon which he had to rely before entering the hospital.

Dr. Pool said the case was shown to emphasize the advisability of doing an anastomosis in cases of this kind. Where the obstruction is very high in the intestinal tract, an enterostomy is to be avoided; therefore, in the presence of multiple bands and adhesions where the obstructing band cannot be readily found or efficiently dealt with an entero-enterostomy may be performed to advantage.

THE DIETETIC TREATMENT OF GANGRENE IN DIABETES MELLITUS.

DR. A. V. S. LAMBERT read a paper with the above title, for which see page 176.

DR. MORRIS thought it very important to consider the character of these infections. Sugar in the blood exerted a hygroscopic action, and extracted water from the normal cells thereby lessening their efficiency as phagocytes or as repair cells. The speaker said he felt convinced that these patients did very much better from a surgical point of view if they were placed on a standard diabetic diet and one that prevented intestinal putrefaction. Dr. Morris said he had brought with him a radiograph demonstrating the calcification of the arteries that Dr. Lambert had described and also a dietary list similar to the one described by Dr. Lambert.

DR. HARTWELL said that at Bellevue Hospital, where they had many of these cases, most of them were treated in the medical wards and received appropriate diet under the supervision of Dr. Graham Lusk. Here the dietetic treatment was much more rigorously carried out than it could be in a general surgical ward. The results had been more satisfactory and much better than when one relied only on the usual surgical methods.

APPARATUS FOR RECTAL ANÆSTHESIA.

DR. EDWARD M. FOOTE described this method, which had recently been first successfully employed by Dr. James T. Gwathmey. It consisted, essentially, of the administration, per rectum, of a 60 per cent. mixture of ether in mineral oil. A cathartic and enema were given the day before operation; while about an hour before operation a hypodermic of morphine was administered. Then the mixture of ether and oil, slightly warmed, was injected through a rectal tube by means of a funnel. The introduction was made slowly, usually employing about four ounces of ether and two ounces of oil. An ounce of ether by measure to thirty pounds of body weight was a safe dose to use. The ether was absorbed gradually but rapidly so that the smell of ether could be detected in the breath in about five minutes, and within fifteen minutes the patient fell quietly asleep, without any struggle or muscular excitement. The patient was under the impression that he was receiving an ordinary enema, and thus mental shock was eliminated, there was no strain on the heart, no interference with respiration, no coughing nor swelling of the mucous membranes. Dr. Gwathmey had now employed the method in over 50 cases. He employed a mixture composed of 75 parts of ether to 25 of olive oil. After the patient was thoroughly under its influence, the excess should be washed out of the bowel. It apparently caused no irritation of the rectum nor of the kidneys, and was eliminated largely by the lungs.

Dr. Foote said that personally he had tried the method in thirteen cases, and so far as his experience with it went, he regarded it as one of the greatest advances in our knowledge of anæsthesia. In some cases where the peritoneum, or other sensitive parts had to be handled, he had found it necessary to give a few drops of ether by the ordinary method. In about one-half of his cases, there was some nausea, but decidedly less than by the ordinary method of etherization. In trifling operations, where prolonged etherization was not necessary, it was not indicated: there nitrous oxide was preferable.

DR. POOL said he had tried this method of etherization in one case at the French Hospital. The operation was a comparatively slight one. The details of the anæsthesia were as Dr. Foote described, but the patient remained in the same condition for four hours.

BOOK REVIEWS

ANATOMY, Descriptive and Applied, by Henry Gray, F.R.S.A., new American from the eighteenth English edition, thoroughly revised and re-edited. By ROBERT HOWDEN, A.M., M.B., C.M., Professor of Anatomy in the University of Durham, England. Philadelphia and New York: Lea & Febiger, 1913.

The nineteenth edition of Gray's Anatomy is a decided improvement over many of the previous editions. The editor has carefully gone over the various chapters, making many needed corrections and additions. Many of the original figures have been removed and new ones added together with a considerable rearrangement of the subject matter.

One of the most important improvements in this volume is the adoption of the Basle nomenclature. The need of this change alone warranted a new edition and the change will be welcomed certainly by the students using the text. Prof. Howden has judiciously used many of the Latin terms directly and in other cases given literal translations of these terms. In but few instances have the old names been used for the translation; for example, the name sciatic has been substituted in the place of the old name, great sciatic, or the Basle name ischiadicus. In other cases, names like anterior nasal aperture, the editor has justly retained in the place of the Latin name, apertura piriformis.

The value of some of the rearrangements in the text may be questioned. Undoubtedly a wise change was made by collecting together into one chapter at the end of the book the various parts given over to surface anatomy. Surface anatomy forms a separate branch of the subject and is best discussed subsequent to a descriptive study of the various parts of the body.

The collecting together of the various parts given over to histology and embryology into one chapter at the beginning of the book are perhaps of much less importance. It is true all text books of anatomy should contain a chapter dealing with fertiliza-

tion, segmentation, and the development of the primary germ layers. The later and more detailed discussion of the development of the organ may be more fitly placed, however, in the chapters dealing with a description of these parts, serving here to make clear the relation and the significance of the various structures. This is especially true in the descriptions of the gastro-intestinal tract, the genito-urinary system, as well as several other organs and tissues.

The publishers have likewise shown a decided interest for the improvement of this volume. The substitution for the harsh and highly colored illustrations of blood-vessels of ones tinted with paler blues and reds and showing some of the general contour of the vessels is much welcomed.

A general criticism that may be justly made of this as well as former editions of the book is the narrow impression of the scope of the subject conveyed through the parts on applied anatomy. The parts deal largely with surgical applications of anatomy. They are useless to the beginning student untrained in clinical branches and still useless on account of their brevity for the student of surgery. Anatomy forms the foundation of all clinical diagnosis and unless it is presented so as to convey to the student its relation to the solution of problems dealing with the life of the individual it remains no longer a science but becomes a mere memory drill.

Aside from this general criticism the reviewing of this book has been a pleasure, since it undoubtedly represents the beginning toward a return of Gray's Anatomy to the high standard it once enjoyed as a text-book of descriptive and applied anatomy.

M. T. BURROWS.

DISEASES OF THE STOMACH. BY GEORGE ROE LOCKWOOD, Professor of Clinical Medicine, Columbia University; Attending Physician, Bellevue Hospital. Octavo, 624 pp. Lea & Febiger, Philadelphia and New York, 1913.

The work is based on the personal observations of the author from material drawn both from private and hospital sources, and represents essentially his individual opinions on diseases of the stomach, his large experience offering him exceptional oppor-

tunities in this line of work. He has, therefore, attempted to state statistics as he has compiled them without regard to previous views held by other authors. This novel method of presentation is plainly noticeable throughout the entire text and it is particularly pleasing to note the absence of the usual historical items, both in text and illustrations, which are so frequently placed for some unknown reason in every text-book.

The text is divided into twenty-one chapters, each practically a monographic report of Dr. Lockwood's own observations, and cover all the essential pathologic conditions present in the stomach. The consideration of surgical intervention in various conditions is fairly stated and judicious in its scope. The freedom of quotation of foreign surgeons and clinicians and the relative paucity of reference to American observers may be noted, as certainly the best work in this field is at present being done here.

The propriety of introducing text and illustrations of methods discarded even by the author himself, as in the case of intragastric faradism, page 330, may be questioned, as may also be the retention of such terms as heart burn, page 478, as a heading which is not only inaccurate but misleading and incorrect.

The dietetic and medicinal treatment of the various disorders is exceptionally commendable and marks a definite departure from previous works in that one does not continually remark that indefinite generality usually accorded these important subjects. A careful consideration of both these methods of treatment, as described by Dr. Lockwood, cannot but be of the greatest benefit not only to the internist, but also to the surgeon.

Differences of opinion may be formed naturally to many statements made, as for instance, that 60 per cent. of patients over fifty years of age have achylia, or that there is a thorough digestion of bread stuffs in the stomach (page 535). But the text is so replete with accurate and scientific observation that these minor differences may be overlooked. Typographical errors, such as the word secretion instead of secretin (pages 509 and 329) will undoubtedly be corrected subsequently.

The introduction of charts to represent the time occurrence of pain is a particularly noteworthy innovation and saves much descriptive text. The illustrations, particularly the radiographic plates, are excellent owing to skilful and commendable retouching.

The book is one which will certainly repay the reader, and

is deserving of close study at this time particularly, when we are gradually entering into phases and treatment of diseases evolved from the physiology of internal secretions and fundamentally based on the pathology of the living rather than the dead.

JAMES T. PILCHER.

CARBON DIOXIDE SNOW. Its Therapeutic Uses. By J. HALL-EDWARDS. Birmingham, London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd. 1913.

In this little volume the author sets forth the methods of collecting, preparing, transporting, and applying carbon dioxide snow in a clear and readable manner. In addition to giving the ordinary means of collecting the snow, the writer describes the use of special apparatus which he has designed for the purpose. The manner of application, effects, length of exposure, and amount of pressure necessary are gone into very thoroughly, and while reference to cases treated has been purposely omitted, a list of diseases in which the snow may be successfully used is given, and the treatment of those conditions in which snow has been most extensively employed is described in detail. The printing is excellent; there are numerous illustrations, and the book may be commended as a reliable guide to those desirous of trying this form of treatment.

JOHN A. C. MACEWEN.

CORRESPONDENCE

THROMBOSIS OF THE MESENTERIC VESSELS.

EDITOR ANNALS OF SURGERY:

Inasmuch as thrombosis of the mesenteric vessels is so infrequently seen, so rarely diagnosed preceding exploratory laparotomy and post-mortem examination, and knowing that the mortality in this disease is so extremely high, 92 per cent. to 94 per cent. (Jackson), I thought it would be of interest to some one to report a case which was referred to me for operation May 6, 1913, by Dr. D. C. Perkins of Jamestown, N. Y.

Patient, Mrs. D., German, housewife, family history negative, mother of eight living children, the youngest five years of age. Patient had always been well up to about January 1, 1913, when she began to have an occasional attack of indigestion associated with vomiting, headache, coated tongue, abdominal pains and unusual constipation. Menstruation regular, piles, and occasionally noticed blood in stools. The above condition persisted, attacks re-occurring about every two weeks, until she entered The Jones General Hospital, Jamestown, N. Y., April 24, 1913, nearly four months after her first attack.

Patient's examination on entering hospital revealed a fairly well nourished woman, but who stated she had lost about fifteen pounds in weight in the previous three months. Physical examination negative, except coated tongue, slight tenderness over the whole abdomen and a few internal hemorrhoids. Temperature 99.5°, pulse 100, respiration 22, urine alkaline, specific gravity 10.18, no sugar, no albumin, complained of some abdominal cramps and did not care for diet.

During the twelve days following admission to hospital, the temperature varied between 99 and 100°, pulse between 90 and 120, respiration 20 to 25, daily vomiting spells, coated tongue, moderate abdominal pains, dark brown stools, and urine normal.

On the thirteenth day after admission, May 6, patient had a severe fainting spell at 10 A.M. after which complained of very severe pain in abdomen, vomited bile, pains continued until 7 P.M. when I was called in consultation. Patient very much under the influence of morphine, abdomen moderately distended and extremely tender, knees flexed, vomiting bile, temperature 99.4°, pulse 140, respiration 32. Diagnosis, obscure abdominal lesion. Patient was immediately prepared for operation.

Under ether anæsthesia by Dr. William M. Bemus, and assisted by Dr. Perkins, by median line incision, the abdomen was opened, in which there was about one pint of brownish fluid and about six feet of gangrenous small intestine extending from a point about four inches from the ileocæcal valve. The mesentery was markedly thickened and œdematous and in it could be seen and felt the thrombosed veins and arteries; all other abdominal organs normal except slight congestion. The fluid was sponged out and 72 inches of ileum resected; the incision at both ends of the diseased intestine being made through the healthy bowel about three or four inches from the line of demarcation. As much as possible of the diseased mesentery, containing the thrombosed vessels, was removed with the diseased bowel. Both ends of the normal bowel were closed and a lateral anastomosis made between lower part of remaining ileum and cæcum.

Punctured cul-de-sac and inserted rubber drainage tube into vagina. The intestines were gently cleansed with salt solution and the abdominal incision closed without drainage.

Patient received subcutaneous salt solution during the following 48 hours, followed by nutritive enemata for five days when they were substituted with beef juice by mouth.

During the three days following operation there was profuse discharge of brownish fluid through cul-de-sac drainage tube. The abdominal wound healed promptly, patient made an uneventful recovery and was discharged from the hospital well, four weeks after her operation. At the present writing, which is six months since her operation, patient is well and is able to do the household work for her family of seven.

Much effort has been made, without success, by Dr. Perkins and myself to discover the etiological factor in this particular case.

Jamestown, N. Y.

F. H. NICHOLS, M.D.

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No. 3

ORIGINAL MEMOIRS

PROSTATISM.

THE SURGICAL ANATOMY AND PATHOLOGY OF THE OPERATIVE TREATMENT.

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THE favorite method of treatment for prostatic dysuria is suprapubic prostatectomy according to Freyer's method. Although it is the rule for a speedy and complete recovery to take place, the operation is associated with a certain mortality and sometimes is followed by disagreeable complications and despite the brilliant successes of a limited number of surgeons, the mortality and after-results obtained by the majority warrant the conclusion that this operation for the relief of prostatic dysuria is neither a safe nor a certain operation in many cases. Reasons may be advanced to explain this state of affairs on clinical grounds, but an accurate conception of them can only be obtained after the surgical pathology of the disease is studied in the light of the operative treatment. It is the object, therefore, of this paper to consider the question of the treatment of prostatic dysuria from the stand-point of its pathology and the pathological findings observed in the parts removed by operation, in cases terminating fatally and in cases dying naturally of the disease. Material of this nature has been examined from 134 cases.

Definition.—The prostate gland is frequently the site of

disease which produces local deformity of the organ, interference with the complete emptying of the bladder, damage to the genito-urinary tract above and serious ill-health of the patient. The clinical indications of these are designated prostatism.

It is recognized that prostatism may arise from a variety of pathological lesions, the majority producing hypertrophy of the gland. All are of the nature of chronic prostatic disease, and at one period are amenable to direct operative treatment. The latter have been gradually evolved until to-day three main routes of access are employed: (1) the suprapubic—extra-peritoneal transvesical; (2) the perineal, and (3) the trans-urethral, the last being used for the division of the constriction by the cautery or prostatic punch.

ANATOMY OF THE PROSTATE GLAND.

The changes met with in the prostate gland in cases of prostatism vary widely and have a morbid anatomy that differs pronouncedly from the normal standard, so much so, that, if the operative treatment of prostatism is carried out solely on an anatomical basis, confusion arises and disaster is liable to follow.

I propose to describe these variations fully, but before doing so, shall refer to certain points in the normal anatomy that are of especial importance and the subject of controversy.

Lobes.—The number of lobes assigned to the prostate gland will depend on the method of anatomical description employed, but whether it be subdivided into two lateral lobes or separated into five segments, as I shall do in this paper, it must be borne in mind, that they form a homogeneous entity, and are fused into a single organ, and that in health, they are no more capable of individual enucleation by blind finger dissection, than are the lobes of the female breast. The gland envelopes the prostatic urethra, much the greater part of it being situated behind it, and is traversed by two channels, the urethra and the ejaculatory ducts, and these may be used to subdivide the gland into five segments. On either side of the urethra lie the *lateral lobes*, in front is the *anterior lobe*, the triangular wedge of gland tissue behind the urethra, and above the ejaculatory ducts forms the *middle lobe*, the corresponding portion below the *posterior lobe*.

Investing Membranes.—These are two in number, the capsule, and the

sheath. The term 'capsule' is used to designate the fibromuscular envelope that surrounds the gland intimately and sends septa into its substance, and is so intimately incorporated with it that it is normally absolutely incapable of separation from it by blunt dissection. The sheath is the outer fibrous investment loosely connected with the capsule of the prostate, except in front where the two membranes are intimately incorporated, and below where it is united to the neck of the gland. The sheath is usually described as being derived from the visceral layer of pelvic fascia, more particularly those divisions of it known as the "vesical" and "rectovesical" layers. Elliot Smith and Derry, following the French School of Anatomists, describe the prostatic sheath as having a three-fold origin. (1) In front it is derived entirely from the mesodermic tissue surrounding the blood-vessels of the prostatic plexus. The puboprostatic true ligament is therefore essentially a vascular cord. (2) Laterally this perivascular tissue also forms the sheath, but it is here reinforced by the fascia covering the inner aspect of the levator ani muscles. (3) Posteriorly it is formed by the fascia of Denonvillier, which is the obliterated lower limit of the rectovesical peritoneal pouch. This peritoneal fossa, in the new-born infant normally reaches as low as the lower limit of the prostate but later this portion of it is obliterated so that two loosely adherent sheets remain between the rectum and prostate and form Denonvillier's fascia.

I have studied the evolution and structure of the prostatic sheath in fifty subjects, the prostate being hardened *in situ*, embedded in celloidin and complete serial sections made with a Bruce's microtome, and confirm the accuracy of the above-mentioned description. The constituent elements of the sheath can be best observed in microscopic sections made of the pelvis of fetal, full-time, and recently-born male infants (Figs. 1-6). They are also easily observed in sections similarly made from the youth and the adult (Figs. 7 and 8).

The description appeals to me on the grounds of its simplicity, and the accompanying illustrations, selected from a large number, demonstrate its accuracy.

Blood-vessels.—The veins of the prostatic plexus are formed mainly from the dorsal vein of the penis which makes the vertical stem of a "Y" lying in front. The limbs of the "Y" pass backward and upward in the vesicoprostatic sulcus and receive the vesical veins as they course back to join the internal iliacs. Veins from the prostate enter the sinus especially in front. Laterally the vessels of the sinus are incorporated in the inner aspect of the sheath. From the point of view of damage to blood-vessels in prostatectomy, the dangerous area therefore lies in front (Figs. 7, 8 and 9).

Lymphatics.—Cuneo, Marcille and Walker have shown how the gathering ground for the periacinous network of lymphatics is a secondary periprostatic plexus from which four main collecting trunks pass. They are symmetrically arranged on either side of the gland, and pass in four different directions. Three pass from the posterior surface to the iliac, hypogastric, and sacral glands. A small channel passes from the anterior surface and terminates in a hypogastric lymphatic gland.

The Musculature of the Prostate and Its Relationship to Muscles.—The stroma of the prostate is richly endowed with non-striped muscle fibre; the gland in fact may be looked upon as being developed by the penetration of gland tubules into an already formed muscular tube (Fig. 2). The vesical muscles are prolonged down into the prostate. The outer longitudinal fibres pass over its capsules, the inner circular are condensed within its upper surface to form the *internal vesical sphincter* (Figs. 10 and 11).

Levator Ani Muscles.—These form a muscular hammock in which the prostate gland is slung. They sweep over the lateral aspect of the gland; their inner fascial covering forming as has been noted the lateral portion of the prostatic sheath. At the apex of the prostate below, they are tied by their fascia to the commencement of the membranous urethra (Fig. 10), and in this position there is situated the external vesical sphincter, a most important muscle, the presence of which is frequently overlooked (Figs. 5 and 10). It is located around the lower limit of the prostatic urethra and extends into the membranous urethra, and must remain undamaged if complete vesical control after prostatectomy is to be absolutely assured (Fig. 12). Adjacent to the external vesical sphincter the rectum is united to the membranous urethra by the recto-urethralis muscle, the muscle fibres of which are obtained from the outer longitudinal muscular coat of the bowel (Fig. 12). These fibres pass like a fan, the handle of which is united to the urethra, the base to the rectum (Fig. 13).

Seminal Vesicles.—The sheath of the seminal vesicles is formed on its posterior aspect from the anterior layer of Denonvillier's fascia, in front from the fascia covering the outer muscular coat of the bladder, to which viscus the seminal vesicles are firmly united. They may therefore be considered as being contained within the upper part of the prostatic sheath. They are also firmly united to the prostate gland (Figs. 14-17).

Practical Deductions, Anatomical.—Before proceeding to consider the pathology of prostatism as the basis for the operative treatment it will be profitable to refer to certain practical deductions that may be made from the normal anatomy of the prostate gland with reference to the operation of prostatectomy. They are mentioned because in certain cases of prostatism the gland, although diseased, maintains its normal anatomical position, relationship and contour.

FIG. 1.



Median-sagittal section of pelvis of male infant at birth showing situation and structure of prostate and seminal vesicles. Note peritoneal recess between prostate and rectum forming Denonvillier's space.

FIG. 2.



Median sagittal section of pelvis of male infant at birth showing prostate, seminal vesicles, and ejaculatory duct. Note the relationship of prostate, veins, Denonvillier's space and recto-urethralis muscle.

FIG. 3.



Horizontal section of pelvis of male infant at birth to show development of prostatic sheath. Note peritoneal recess between rectum and prostate and structure and relationship of capsule and sheath.

FIG. 4.



Horizontal section of pelvis of male infant at birth to show development of prostatic sheath at lower level than the former showing verumontanum and obliteration of peritoneal recess forming Denonvillier's space.

FIG. 5.



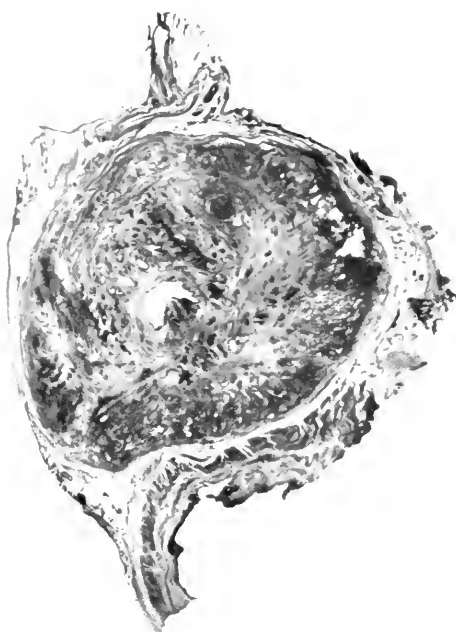
Horizontal section of pelvis of male infant at birth to show development of prostatic sheath, section at apex of prostate showing external vesical sphincter.

FIG. 6.



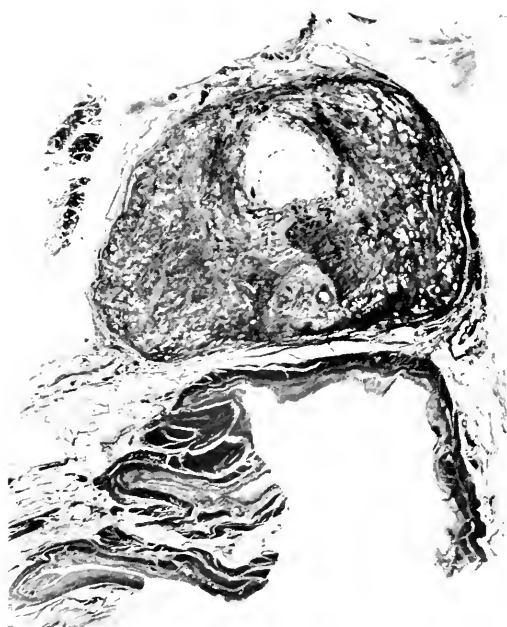
Horizontal section of prostate of infant of four months showing structure of prostate and development of sheath. Note the relationship of the sheath to vessels in front and to levatores ani latterly.

FIG. 7.



Horizontal section of prostate and rectum of young adult showing the structure and coverings of prostate.

FIG. 8.



Horizontal section of prostate and rectum showing relationship of veins of prostatic plexus, prostate and space of Denonvillier between prostate and rectum.

FIG. 99



Horizontal section of prostate of man aged sixty, showing early chronic lobular prostatitis (prostatic hypertrophy) and illustrating relationship of veins of prostatic sinus.

FIG. 10.



Coronal section of adult prostate showing (1) formation of internal vesical sphincter from circular muscular coat of bladder, (2) external vesical sphincter surrounding apex of prostate and urethra, (3) indirect attachment of levator ani muscles at apex, and (4) muscular hammock in which the prostate is slung.

FIG. 11.



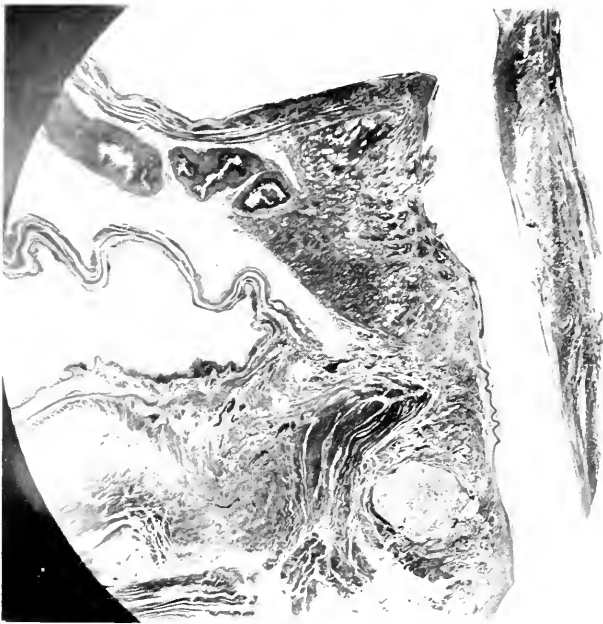
Vertical section, prostate, showing relationship to muscular coats of bladder and formation of internal vesical sphincter.

FIG. 12.



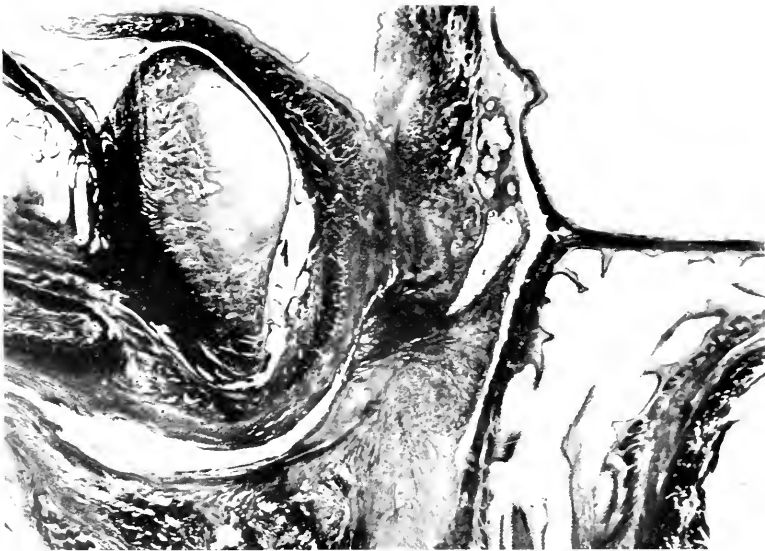
Horizontal section of urethra at apex of prostate showing external vesical sphincter surrounding urethra, and recto-urethralis muscle formed from external longitudinal muscular coat of rectum behind.

FIG. 13.



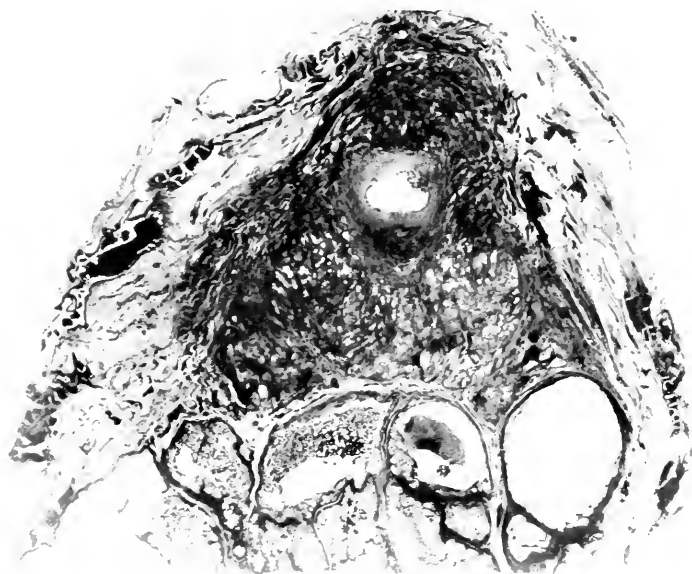
Median sagittal section, prostate, and rectum showing formation of recto-urethralis muscle and situation of Cowper's gland.

FIG. 14.



Median sagittal section of pelvis of male infant at birth showing situation, structure and relationship of seminal vesicles and ejaculatory duct.

FIG. 15.



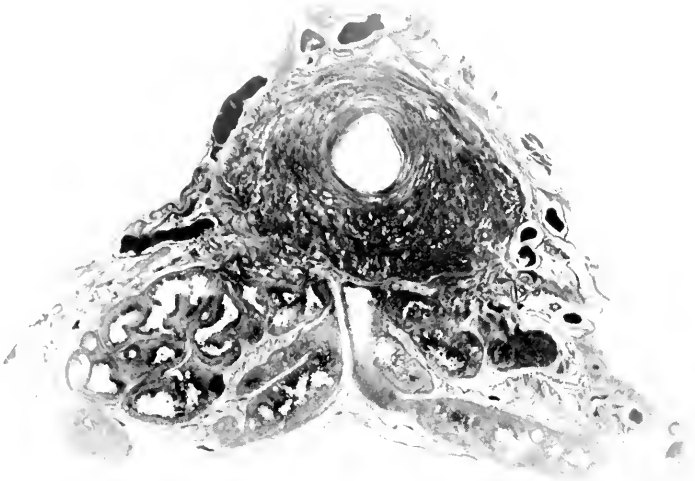
Horizontal section of prostate and seminal vesicles, showing middle lobe of prostate and its relationship to vesicles.

FIG. 16.



Median sagittal section of prostate showing situation, structure and relationship of seminal vesicles.

FIG. 17.



Horizontal section of prostate and seminal vesicles showing the fascial investment of vesicles and its relationship to prostate and blood-vessels.

FIG. 18.



Horizontal section of prostate removed by the operation of suprapubic prostatectomy for chronic lobular prostatitis (prostatic hypertrophy). The prostate was smaller than natural size; but shows advanced disease.

When the prostate gland possesses the gross structure and relationships of the normal organ:

1. Total subcapsular enucleation by finger dissection is impossible.

2. Extracapsular enucleation by finger dissection is possible but an extremely difficult and dangerous proceeding.

3. Total excision necessitates a separation of the capsule from the sheath and as these are intimately incorporated in front the vessels of the prostatic plexus must be wounded.

4. To gain access to it from above by the suprapubic transvesical route necessitates division and possible destruction of the internal vesical sphincter, the normal prostate being an extravescical organ.

5. The external vesical sphincter will be damaged and possibly destroyed.

6. The space of Denonvillier must be opened up and as this is a very loosely obliterated peritoneal pouch, the retroperitoneal cellular tissue planes are in consequence opened as a path along which extravasated blood or an infecting virus may readily extend into the pelvic or extraperitoneal cellular tissue, if the space is not freely drained.

7. Conservation of the ejaculatory ducts is impossible in total excision by the transvesical route.

8. The seminal vesicles are likely to be damaged in enucleation and must be dissected free in excision.

PATHOLOGY OF PROSTATISM.

Incidence of Disease.—The frequency with which chronic prostatic disease producing prostatism occurs is difficult to estimate. Richardson states that chronic prostatic enlargement has been found in 34 per cent. of men over the age of sixty, and of that number 15 per cent. suffer from symptoms. Plondke has estimated that 33 per cent. of all men over 50 years of age suffer from enlarged prostate and that 10 per cent. of these require treatment. He also says that catheter life results in 100 per cent. mortality within an average period of 4 years. Personally I am unable to give accurate data not

having made enough observations to warrant definite conclusions.

Varieties of Chronic Prostatic Disease Producing Prostatism.—As I have already mentioned, I have examined specimens from 134 cases of this nature and these have included cases operated on for prostatism, cases dying naturally of the disease without treatment, and fatal cases where operative treatment has been carried out. In all of them the tissue removed was sectioned in celloidin. Paraffin sections were made of smaller portions for more accurate histological examination. Serial celloidin sections were made in most of the cases. They showed three outstanding varieties of disease leading to prostatism—(1) prostatic hypertrophy, or as I would prefer to call it, chronic lobular prostatitis (110 cases); (2) prostatic fibrosis or chronic interstitial prostatitis (10 cases); (3) prostatic carcinoma (14 cases).

Prostatic Hypertrophy of Chronic Lobular Prostatitis.—The frequency of incidence of this variety of prostatic disease as the cause of prostatism is such as apparently to lead occasionally to the belief that it is the only cause.

The etiology of this disease has been the subject of much dispute. Wilson and McGrath in their recent article enumerate 13 different theories that have been advanced to explain its origin. I do not propose to enumerate these but would suggest that the changes met with in this disease are in their essential nature so closely identical with those observed in another accessory sexual gland, the female breast, when the site of multiple cystic disease or chronic lobular mastitis, that their origin probably resides in factors that are essentially identical. In both cases the gland involved produces an accessory sexual secretion and we know now that the natural stimulus to increase functional activity in the case of the mammary gland comes to it in the form of a hormone, that would appear to be formed in the corpus luteum of the ovary subsequent to impregnation.

I am not aware whether physiologists have worked out a similar relationship between the testicle and the prostate but

it seems rational that such should exist, otherwise, the relationship of the testicle and the prostate has been widely investigated. Richardson has shown that the fecundity of an animal is in proportion to the state of development of the accessory genital glands, the most important of which is the prostate. It is also known that when an animal is castrated before the age of puberty, the full development of the prostate gland is prevented; where that gland is removed, however, in later life no essential atrophy of the prostate results. It appears to me likely that prostatic hypertrophy will be found to owe its origin to some alteration in a normal internal secretion.

I do not consider the changes found in the gland in cases of prostatic hypertrophy or, as I have called it, chronic lobular prostatitis to be indicative of a truly neoplastic process.

In chronic lobular mastitis and chronic lobular prostatitis a senile hyperplasia is present. An aberrant overgrowth of tissue occurs that is not the result of the appearance of an independent new growth, although in both cases there is a pronounced liability for the development of the same. They are liable to undergo malignant changes and to develop carcinoma. Although the changes are essentially similar, they are modified by the situation in which the glandular overgrowth has occurred. The prostate gland being firmly encapsulated and possessing a stroma so abundantly provided with muscle fibres, these tend to confine the overgrowth and produce zones of false encapsulation. Where the area of overgrowth in the prostate gland is situated near a free surface, the muscle fibres lead to its partial extrusion, in a manner similar to that in which the uterine fibromyoma is treated, when situated in the wall of the uterus. A similar process is observed in the alimentary canal with gastric and intestinal polypi.

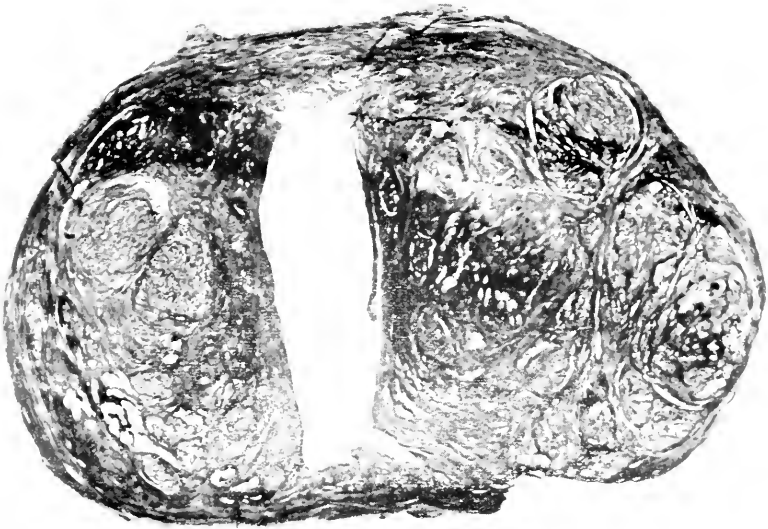
The process known as prostatic hypertrophy, or chronic lobular prostatitis, is virtually always associated with a great increase in the size of the gland, but it is occasionally met with in glands that are even smaller than normal, but clinically have produced pronounced indications of prostatic dysuria (Figs. 18 and 19).

Tandler and Zuckerkandl as a result of their investigations made on subjects dying naturally with prostatic hypertrophy claim to have shown that the process is always found involving the middle lobe. In those cases that I have examined, it is undoubtedly by far and away most commonly met with in that situation, but it is also clear that the lateral lobes are frequently involved. In one specimen the disease was confined to the anterior lobe (Fig. 20). This later condition is, however, unique.

When the hypertrophic process is confined to the middle lobe, or involves at the same time the lateral lobes, the ejaculatory ducts are displaced downward, and the posterior lobe is compressed and atrophied, and the seminal vesicles are displaced backward (Fig. 21). The importance of these changes is that the seminal ducts are carried into a region of safety, and are conserved during the operation of suprapubic transvesical prostatectomy for this disease.

When the prostate gland, the site of chronic lobular prostatitis, is sectioned and examined, it is usual to observe areas of glandular overgrowth in the later stages of which certain of the spaces become distended and show the thin wall and other characteristic appearances of a retention cyst. It is also the rule for corpora amylaceæ to be scattered throughout the area of disease. The frequency, size, and consistence of these can be well understood, when I state, it was our experience to find that in sectioning the celloidin specimens, it was the rule for the edge of the microtome knife to be broken in one out of every three specimens sectioned, owing to these stony little foreign bodies. The unaffected gland tissue is compressed and condensed along with the interglandular stroma (Fig. 22). Toward the surface of the gland, this change results in the formation of a false capsule which consists mainly of muscle strands, and fibrous tissue, but in it there can always be observed compressed and atrophied glandular acini, and these are frequently flattened out, and form a line of natural cleavage which permits of the easy separation of the diseased tissue beneath from the false capsule surrounding it without (Fig. 23).

FIG. 19.



Horizontal section, prostate, removed by the operation of suprapubic prostatectomy for chronic lobular prostatitis (prostatic hypertrophy). Gland smaller than natural size but shows advanced disease.

FIG. 20.



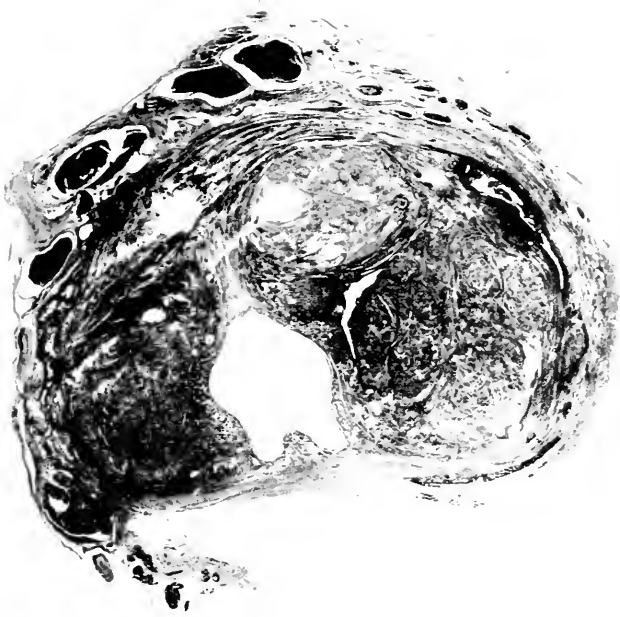
Median sagittal section of prostate and rectum showing prostatic hypertrophy (chronic lobular prostatitis) confined to anterior lobe.

FIG. 21.



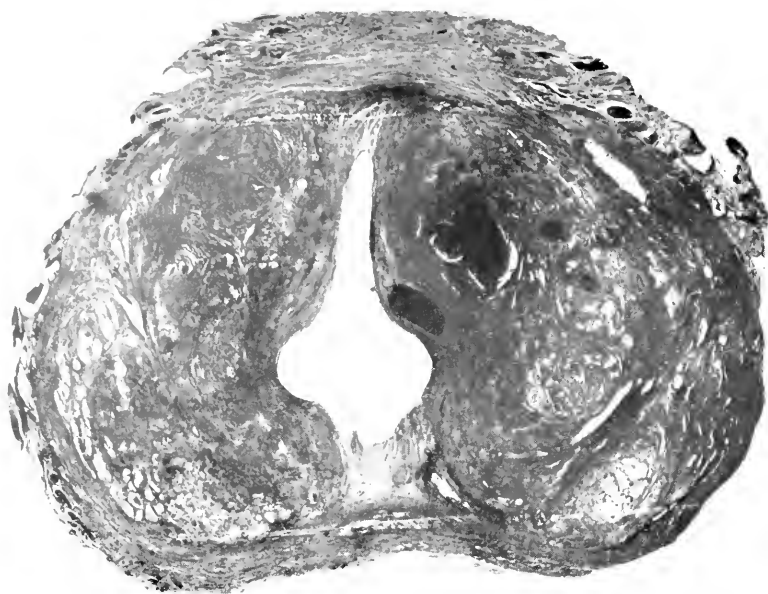
Median sagittal section of bladder, prostate, and seminal vesicles showing extreme hypertrophy of middle lobe from chronic lobular prostatitis with intravesical herniation and displacement of seminal vesicles and ejaculatory duct, and condensation of posterior lobe

FIG. 22.



Horizontal section of prostate, the site of advanced chronic lobular prostatitis (prostatic hypertrophy) showing nodular hypertrophy in lateral lobes, formation of false capsule from uninvolved and condensed prostatic tissue and relationship of blood-vessels in sheath to this.

FIG. 23.



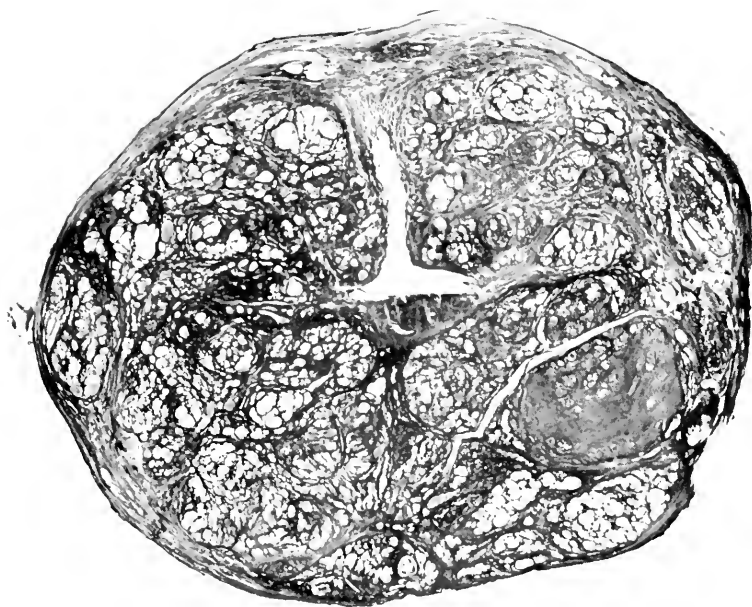
Horizontal section of prostate, the site of advanced chronic lobular prostatitis (prostatic hypertrophy) showing natural line of cleavage formed by flattened gland acini beneath false capsule.

FIG. 24.



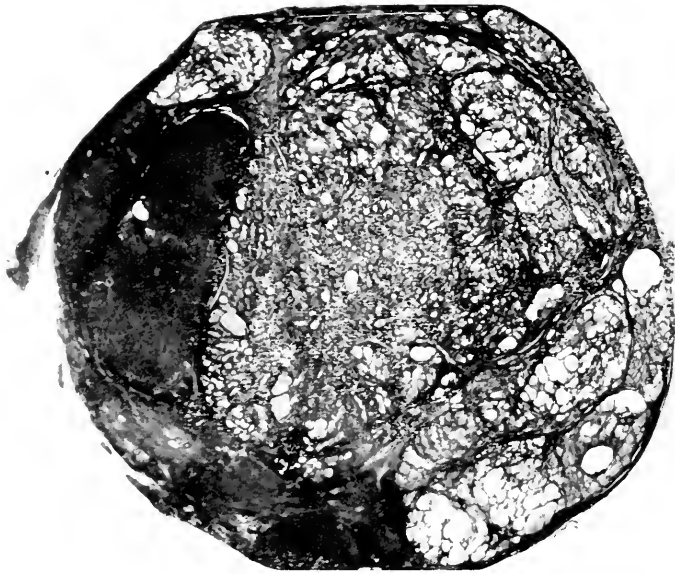
Horizontal section of prostate, the site of advanced chronic lobular prostatitis (prostatic hypertrophy) showing encapsulation by false capsule of one lobe.

FIG. 25.



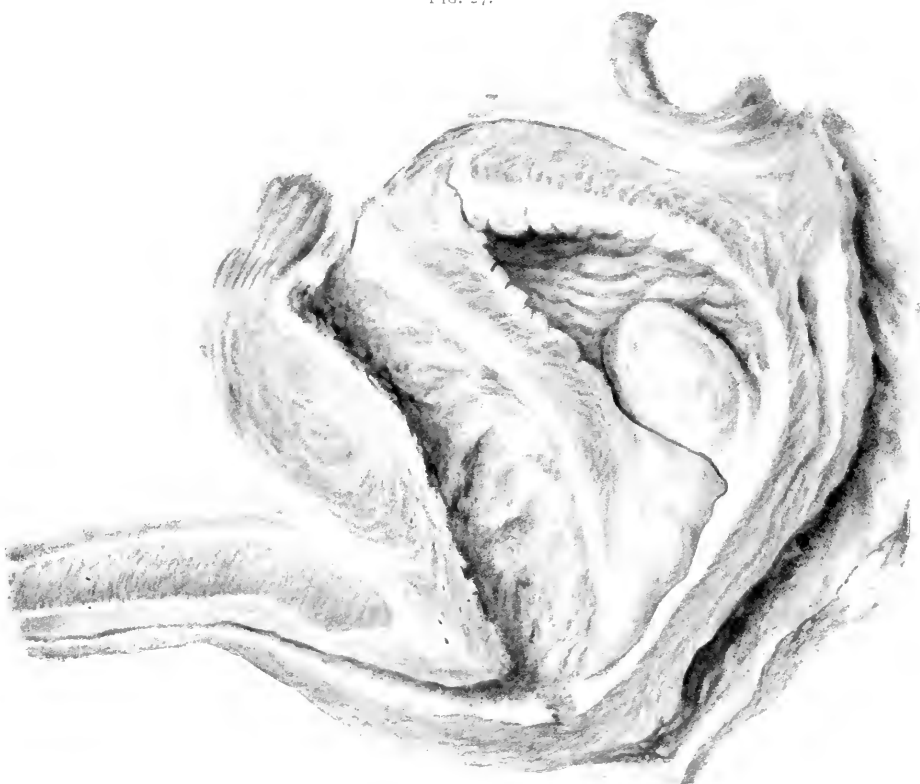
Horizontal section of prostate removed by suprapubic prostatectomy. "total" enucleation for chronic lobular prostatitis (prostatic hypertrophy) showing one fibromyomatous nodule.

FIG. 26.



Horizontal section of one lobe removed by suprapubic prostatectomy, "lobar" enucleation showing fibromyxomatous nodule.

FIG. 27.



Median sagittal section of pelvic contents of man aged seventy-three, who died from rupture of urethra with extravasation of urine into space of Retzius, showing hypertrophy of middle lobe of prostate which projects into bladder. Water color drawing of case from which Fig. 21 was made.

FIG. 28.



Median sagittal section of bladder, prostate, and rectum showing middle lobe forming median prostatic "bar" in case of chronic interstitial prostatitis.

FIG. 20.



Horizontal section of prostate and rectum from a man aged seventy-three, who died suffering from prostatism, showing diffuse chronic interstitial prostatitis.

In a typical case these flattened acini form an arrangement somewhat like the perforations around a postage stamp, the perforations being, however, longer and the bridges much further apart.

The arrangement of the spheroids frequently permits of their removal in two masses so that at the operation the hypertrophied gland is described as being removed in two lobes (Fig. 24). Very occasionally a spheroidal area of hypertrophy is seen where the stroma is increased very much in amount, and the gland tissue much reduced in quantity, so that a fibromyomatous nodule is produced (Figs. 25 and 26). These are, however, not true neoplasms, and of all the cases in which I have observed it, in only one did I fail to detect the presence of atrophied gland tissue amidst the fibrous and muscular tissue, and in this case circumstances did not permit of a complete section of the entire gland. These fibroid areas are probably the result of a former inflammatory process. When the prostate gland enlarges in chronic lobular prostatitis, in addition to producing for itself a false capsule, it herniates itself through the internal vesical sphincter and comes to lie directly beneath the thin mucous membrane of the bladder floor (Figs. 21, 27, and 60).

Prostatic Fibrosis or Chronic Interstitial Prostatitis.—Of the 134 cases I have examined, ten suffered from prostatic fibrosis or chronic interstitial prostatitis. In this disease the prostate gland is smaller than normal and is of a firm fibrous consistence. The interglandular stroma is increased in amount, the whole organ being of a sclerotic nature.

It may be considered as having its origin in those various factors that so commonly produce fibrous overgrowth in the interglandular stroma of various organs of the body. The circulating toxin that has produced chronic interstitial nephritis may in a like manner produce chronic interstitial prostatitis. When the middle lobe of the prostate is especially involved, a fibrous sclerotic bar is produced, which mechanically leads to interference with the voiding of urine from the bladder and a severe degree of retention may result (Fig. 28).

It is of importance to realize clearly the morbid anatomy associated with this disease and wherein it differs from that present in chronic lobular prostatitis. In chronic interstitial prostatitis (Fig. 29) no false capsule is found surrounding the gland, there being no formation of spheroids in this condition. The natural union between the prostate gland, its capsule, and sheath, is more intimate than normal. There is no intravesical herniation of the gland so that consequently it retains its normal relationship to the internal and external sphincters.

When sections of the gland, the site of chronic prostatitis, are examined the appearance seen is very comparable to those observed in a cirrhotic kidney or liver. The glandular tissue is compressed and atrophied by strands of fibrous tissue amidst which portions of degenerative muscles are situated. Throughout the stroma, areas are present where small cells mainly of the lymphocyte type are accumulated, such as are constantly observed in processes of a similar nature elsewhere.

From the point of view of its morbid anatomy, therefore, the prostate gland in which chronic interstitial prostatitis is present differs in almost every respect from that in which chronic lobular prostatitis has occurred. It is perhaps, its misfortune that the only features it shares in common are the clinical indications of prostatism that are so closely similar as to tempt certain surgeons to treat them by a similar operative technic with occasionally disastrous consequences.

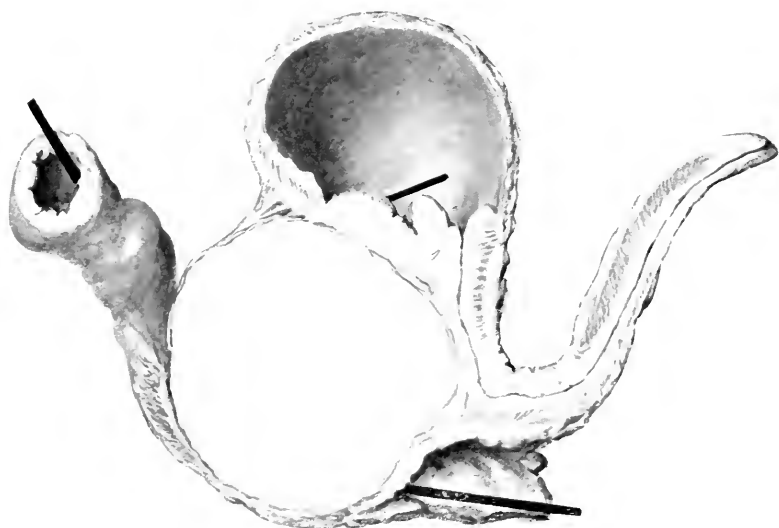
Carcinoma of the Prostate.—Of the various neoplasms of the prostate, carcinoma occurs so frequently and other tumors, both innocent and malignant, so rarely as to justify us in confining our attention entirely to the former.

The only true innocent neoplasm of the prostate I have so far personally discovered was an angioma, which was found accidentally in a post-mortem room specimen.

Sarcoma of the prostate is rarely met with. The Museum of Saint Bartholomew Hospital contains a specimen illustrative of this disease and by the courtesy of Dr. Andrews, I am able to show a drawing of it (Fig. 30).

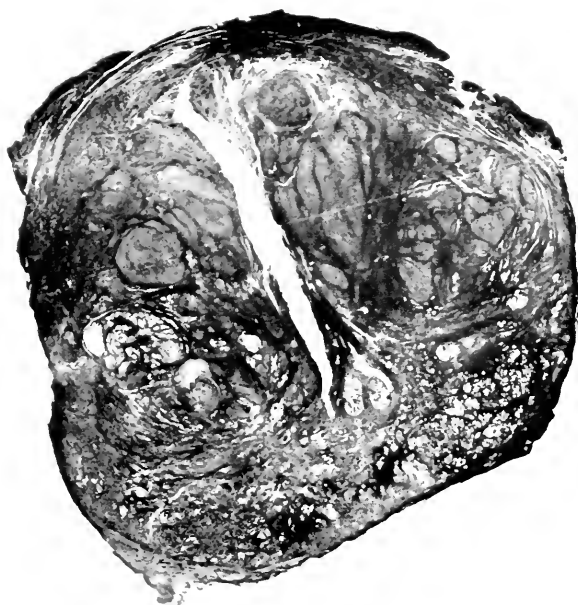
According to Young's most recent statistics completed

FIG. 30.



Median sagittal section of bladder, prostate and rectum of a boy with sarcoma of prostate.
(From the Museum of St. Bartholomew's Hospital by the courtesy of Dr. Andrews.)

FIG. 31.



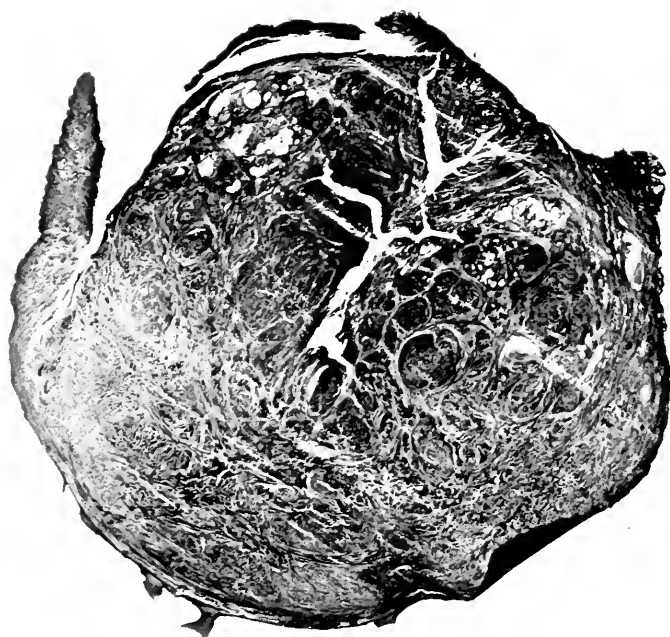
Horizontal section of prostate removed by suprapubic prostatectomy, "total" enucleation showing carcinoma along with chronic lobular prostatitis (prostatic hypertrophy), and portion of prostatic sinus adherent.

FIG. 32.



Horizontal section of prostate removed by suprapubic prostatectomy showing carcinoma along with chronic lobular prostatitis (prostatic hypertrophy).

FIG. 33.



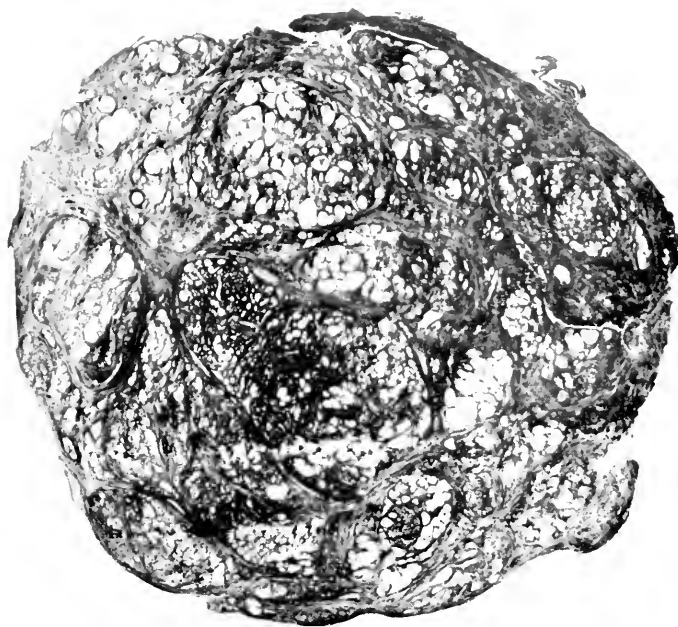
Horizontal section of prostate removed by suprapubic prostatectomy showing scirrhous carcinoma.

FIG. 34.



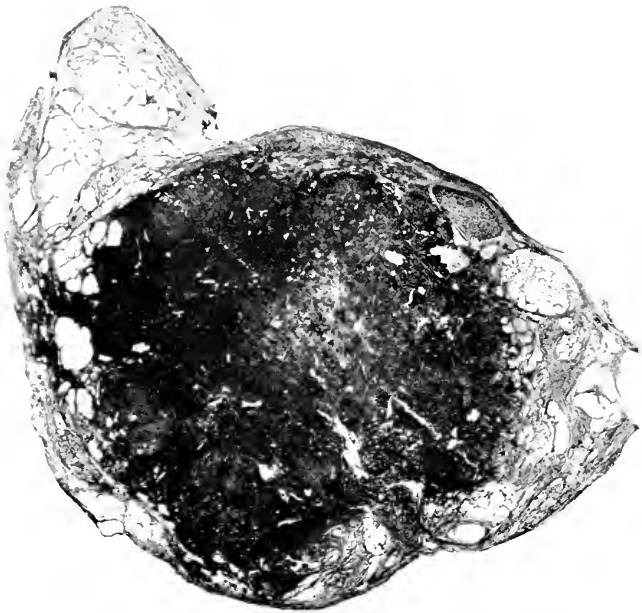
Sections of portions of prostatic carcinoma removed by the operation of suprapubic prostatectomy.

FIG. 35.



Section of one "lobe" of prostate removed by suprapubic prostatectomy showing chronic lobular prostatitis (prostatic hypertrophy). No signs of carcinoma.

FIG. 36.



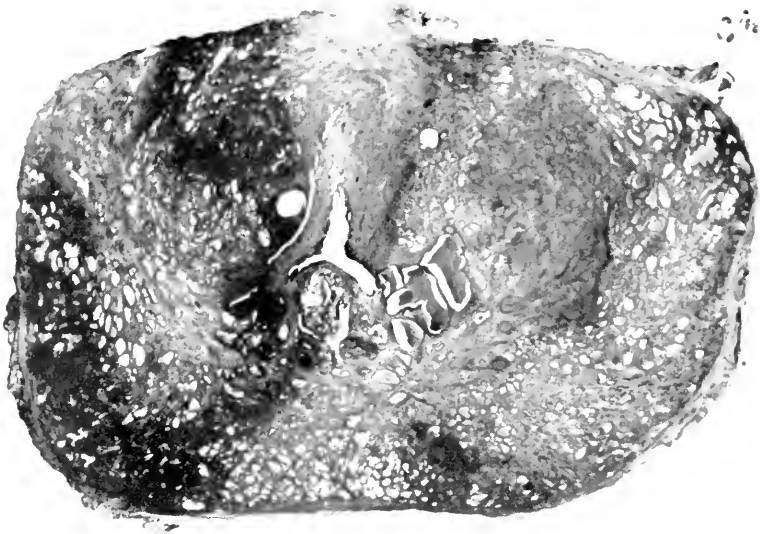
Section of "lobe" of prostate removed by suprapubic prostatectomy showing carcinoma along with chronic lobular prostatitis (prostatic hypertrophy). (Figs. 35 and 36 were from the same case, the tissue being removed in two "lobes.")

FIG. 37.



Horizontal section of prostate showing carcinoma infiltrating neighboring tissues implicating the vessels of the prostatic sinus and fixed to rectum.

FIG. 38.



Horizontal section of prostate removed by suprapubic prostatectomy showing early carcinoma and chronic lobular prostatitis (prostatic hypertrophy).

from cases in his own clinic, one case in five of prostatic enlargement causing obstruction in old men is due to cancer. Out of the 134 cases investigated that form the basis of this communication 14 showed carcinoma of the prostate to be present, or approximately one in ten.

The clinical records of fully an equal number of cases of cancer treated by palliative measures, the prostate not being removed, exist, but as no material was available for investigating the morbid anatomy, they are of course not included; but they go to further confirm the accuracy of Young's statement of the frequency of prostatic carcinoma.

In ten of the fourteen cases, prostatectomy was performed and in six of them chronic lobular prostatitis was also present; and had obviously existed antecedent to the onset of cancer, and probably predisposed to its development (Figs. 31 and 32).

Three types of carcinoma were found (Figs. 33 and 34): (1) Scirrhus; (2) medullary; (3) adenocarcinoma. They were very comparable to the types met with commonly in the female breast and showed a similar degree of malignancy, the last, like the adenocarcinoma of Halsted, being the least malignant. Wilson and McGrath have noted how carcinoma of the prostate is frequently only revealed on careful examination of the specimen after its removal by prostatectomy. In the ten specimens obtained by me from the operating theatre, this proved to be the case. They showed how fortunately at first it is the rule for the malignant disease to commence in the centre of an area of chronic lobular prostatitis, so that at first enucleation is rendered even more easy. Complete celloidin sections being made, they also showed how necessary it is to obtain a complete section for examination before a certain opinion can be expressed on the presence or absence of carcinoma.

In one case this was especially borne out (Figs. 35 and 36). The patient underwent prostatectomy, a "lobular" removal being carried out. Clinically, carcinoma was not suspected and the ease with which prostatectomy was accomplished combined with the speedy and uneventful recovery of the patient did not arouse the suspicion that cancer was present. On examining

the specimens, however, it was found that one "lobe" was the site of typical chronic lobular prostatitis (Fig. 35), while the other showed the same change, but in addition there was present in the centre of it a mass of carcinomatous new growth (Fig. 36).

The presence of this was borne out clinically eight months later when the disease recurred and led to the death of the patient from cancer.

When carcinoma of the prostate has progressed beyond this early stage of centrally situated disease, one of three results may follow, when the operation of suprapubic prostatectomy by blind dissection is attempted, either the removal is accomplished with difficulty, a "total" prostatectomy being achieved (Figs. 31 and 38), or this being impossible, fragments of the diseased gland are extracted with difficulty, danger, and doubtful benefit to the patient (Fig. 34), or the disease is found to be so widespread, involving the adjacent blood sinuses and neighboring glands and consequently incapable of even partial removal (Fig. 37).

DURATION OF LIFE AND CAUSE OF DEATH IN UNTREATED CASES OF PROSTATISM.

Accurate observations on this most important question are difficult to obtain. We wish to know the general frequency of chronic prostatic disease, the duration of life in cases having absolutely no treatment and the causes of death in these. It is also important to possess if possible similar records of the fate of those who have led what is described as a "catheter" life. It has been already mentioned that Plondke has estimated that 33 per cent. of all men over fifty years of age suffer from enlarged prostate and that 10 per cent. of these require treatment and that, he also says, even catheter life results in a 100 per cent. mortality in an average period of four years.

In the absence of the necessary complete data accurate deductions are difficult; but we certainly know that the cases diagnosed early and treated early recover much more frequently than those where the opposite state of affairs holds

FIG 39.



Unilateral acute consecutive suppurative nephritis following prostatism due to chronic interstitial prostatitis. Showing numerous small abscesses in the kidney, hydronephrosis dilatation of both ureters and recent acute cystitis.

good. It is also a fact beyond dispute that pronounced prostatism causes a profound alteration in the genito-urinary tract above. The bladder becomes hypertrophied, dilated, and sacculated. The ureters and renal pelves are similarly dilated and hydronephrosis with pronounced renal atrophy occurs. I have also observed how even in early cases chronic interstitial nephritis is present, and am of the opinion that prostatism may act as a cause of this later change. When interstitial nephritis is present it certainly aggravates it.

In cases dying naturally of prostatism, two forms of death are observed. In one a sudden renal infection brings the patient to a surgeon under whose care he rapidly expires, with or without operative treatment, from acute consecutive suppurative nephritis. In these cases, the organism has usually entered the blood stream from a focus of infection in the lower urinary tract and been determined to the kidney, whose power of resistance to infection has been weakened by prolonged backward pressure. The accompanying illustration (Fig. 39) shows this condition. The patient was a laborer, who had suffered for three years from pronounced prostatic dysuria due to chronic interstitial prostatitis. He had received no treatment and when admitted to hospital was in a dying condition. The post-mortem examination revealed chronic interstitial prostatitis with backward pressure, recent acute cystitis and acute unilateral consecutive suppurative nephritis.

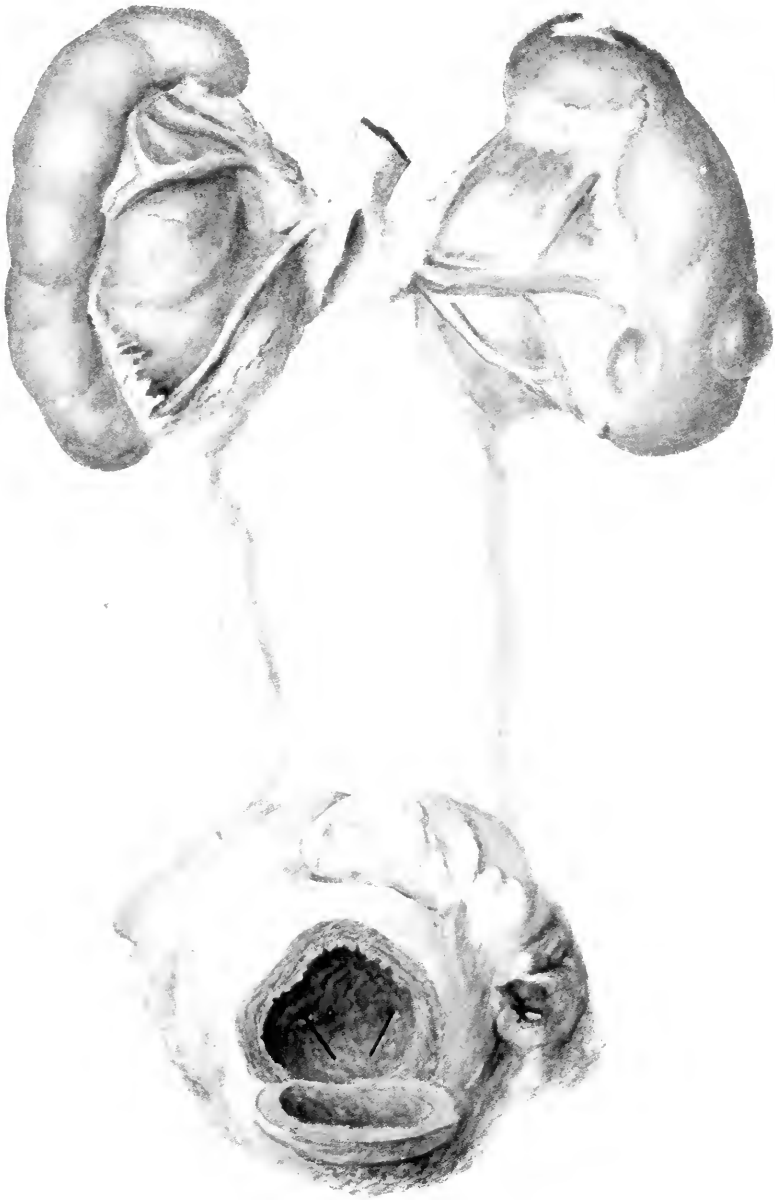
On the other hand, a slow renal destruction from persistent backward pressure may bring the patient within the care of the physician. The patient's loss of weight, persistent sickness and failing heart naturally lead to attention being directed mainly to the state of his cardiovascular system. The prostate is probably never mentioned by the patient and is occasionally unsuspected by his medical attendant as the primary cause of his illness and he dies, breaking up in a manner that is characteristic of so many medical ailments. It has been my experience to personally encounter two such cases of this nature. The most typical was that of a man who consulted

me with reference to the early indications of prostatism from which he suffered. It was a number of years ago, and he was in so excellent health at the time, that I considered it only honorable to dwell at considerable length on the risks of operative treatment for his enlarged prostate. This course I advocated strongly, but he declined and I lost sight of him for two years and a half, when I accidentally discovered him in a medical ward a physical wreck, dying from a failing heart, backward pressure and uræmic poisoning.

Some times such a case comes under a surgeon's care at a stage just prior to the final general breaking up. At this period, the appearance of the patient is sometimes most deceptive. His general health is stated to be good. The amount of urea present in the urine is diminished but to no excessive degree. The ordinary tests of renal functional activity when employed indicate a certain degree of renal insufficiency. Deceived by a fictitious appearance of general good health, the surgeon may operate, as was done in the case from which the accompanying illustration (Fig. 40) was taken and the patient dies, slowly sinking from no obvious and apparent cause or complication, and at the post-mortem examination, the ureters are found to be dilated to a size almost equal to the calibre of the small intestines, and the renal pelves are dilated to such an extent, that the parenchyma is reduced to a thin rim on the surface of two thin-walled multilocular sacs which are all that represent the kidneys.

During the post-mortem examination of patients who have died of various diseases in the medical wards of the hospital, there can frequently be observed, in male subjects over the age of 50 years, indications of a mild degree of chronic prostatic disease with associated damage to the urinary tract above. It is virtually always found that no complaint has been made of this by the patient. It is usually unsuspected, and has virtually never received treatment. In these cases, however, the ureter and renal pelves are dilated to a moderate extent and there is present a recent interstitial nephritis throughout both kidneys, and the renal parenchyma shows

FIG. 40.



Extreme backward pressure produced by prostatic hypertrophy. Note extreme dilatation of both ureters and renal pelvis and extreme atrophy of renal secreting tissue.

indications of pressure atrophy through its substance. When the pathology of these cases is viewed by one with a surgical mind, it is impossible to avoid the conclusion that the renal destruction, as a result of the partial retention of urine from the prostatic disease, has contributed to a certain extent to lowering the patient's power of resistance to a general infection, or has poisoned the heart muscle by the retained products of metabolism which should be normally excreted by the healthy kidney.

THE SURGICAL PATHOLOGY OF THE OPERATIVE TREATMENT.

The mortality associated with the operation of prostatectomy is high. According to the published statistics of one of the largest hospitals in this country, out of 164 cases operated on during ten years 54 died, a mortality of 35.4 per cent. During the five years from 1906-1910, 69 cases were treated by suprapubic prostatectomy in Saint Thomas' Hospital. Of these, 14 died, a mortality of 20.3 per cent. According to Page, the mortality after the operation of suprapubic prostatectomy for adenomatous enlargement in the four London Hospitals of St. Bartholomew's, University College, Westminster, and Middlesex, during the period from 1906-1910 was 21.5 per cent.; 26 cases being operated on, of which 16 died. The mortality of the 1000 cases operated on by Freyer is returned by him at 5.5 per cent. In his first 100 cases, it was 10 per cent.; in his last 400, 4.5 per cent. In the last 100 there were only three deaths.

The operation of perineal prostatectomy has been especially practised in America by Young. In the last report of the International Association of Urology, he mentions that he has operated on 450 cases of benign disease by perineal prostatectomy, of these 17 died, a mortality of 3.77 per cent. These results, from the point of view of successful operations, appear to be the best in existence.

In the above-mentioned report, there is also contained the results obtained by a number of other experts and Rovsing's remarks at the above-mentioned congress are well worthy of

being referred to. He reported the result of 25 prostatectomies performed by himself for prostatic hypertrophy: 22 were suprapubic and 3 perineal. Three of the former died, a mortality of 13.6 per cent. and one of the latter, a mortality of 33.3 per cent.

His contribution to the discussion is of especial interest in that, in discussing the question of mortality, he mentions a point that must be in the minds of most of us, that the mortality of Freyer and Young which was returned at from four to five per cent. must not be taken as an indication of the general mortality throughout the world. He says. "We must not let ourselves be led into believing that this is the real mortality of the operation as regards the great number of surgeons; you will find a far higher rate of mortality from this operation in the wards of the large hospitals all the world over. In my opinion, this is not due only to deficient technic as compared with that of the specialist, perhaps, least of all so, but far more to the advanced stages of disease of the cases. The true mortality certainly cannot be estimated at less than 10 to 20 per cent."

We have observed when considering the pathology of those cases that died from prostatic disease without receiving treatment, how prostatism if untreated rapidly undermines the patient's health and power of resistance to infection, so that many patients are really in a dying condition when they come under the care of a surgeon.

Page has compiled from the statistical returns of Saint Thomas' Hospital, returns that form a most interesting comparison in this connection. He has collected the cases of prostatic disease that were admitted to hospital and tabulated these according to the variety of treatment they received. The total number of cases treated was 132 and the mortality over all was 21.7 per cent. Those treated by catheterization had a mortality of 22.7 per cent. Those treated by suprapubic drainage, a mortality of 20 per cent. and those by suprapubic prostatectomy a mortality of 20.3 per cent.

The value of these latter results is wherein they show the extent to which the patient's health was broken down prior to any surgical treatment, however simple, being adopted for the relief of the disease.

Those statistics showing the mortality attending the treatment of prostatism are not quoted by me to support the advocates of any of the alternative routes of operation employed and I do not ask that undue importance be attached to them. What to me appears to be of great moment is the fact that the mortality attending prostatectomy, as practised in general hospitals, has not shown in recent years that degree of reduction we might have been led to expect and what is of greater moment is that cases are occasionally seen that in the light of our present knowledge appear eminently to justify operative treatment. The operation proves simple and uncomplicated and still the patient dies from causes that would appear to be virtually unavoidable.

CAUSES OF DEATH AFTER PROSTATECTOMY.

From the records of Saint Thomas' Hospital, Page has constructed a statistical analysis of the cause of death after suprapubic prostatectomy, but space will not permit of my referring to his observations in detail. It is sufficient for our present purpose to mention that, of the 15 fatal cases examined by him, 10 died within a week of operation and the majority of these from an acute local infection or from acute suppurative nephritis. An analysis of the 68 fatal cases that have occurred in the hospital to which I am attached has given a very similar result and has gone to show that by far and away the commonest cause of death after suprapubic prostatectomy is septic absorption, arising out of the wound inflicted. And second, it has shown the fact, that the majority of cases of prostatism operated on in the wards of a general hospital are extremely bad lives from the actuarial stand-point on account of the pronounced degree of chronic renal disease from which they suffer.

THE LOCAL RESULT OF SUPRAPUBIC PROSTATECTOMY.

A considerable amount of discussion has centred round the questions, what is removed when suprapubic prostatectomy is performed and what remains of the gland after the operation is completed?

I would propose to show that the change produced in the prostate gland by the operation of suprapubic prostatectomy is determined mainly by the nature of the disease present in it. We will consider first the immediate consequences of Freyer's operation as performed for hypertrophy or chronic lobular prostatitis. When the operation is performed, the tissue removed is found to come away in one of four different methods: (1) "Total" enucleation along with the prostatic urethra; (2) "total" enucleation with conservation of the prostatic urethra; (3) lobar enucleation; (4) nodular enucleation.

1. *"Total" Enucleation with Removal of the Prostatic Urethra.*—Under this heading are included those cases where the mass of tissue is removed in one piece, and is traversed by the prostatic urethra which has also been removed. When the specimen is examined after removal, it is found usually to have a regular contour and to be coated with muscle fibres arranged concentrically around it. In appearance, it resembles the enlarged prostate gland, but when it is examined, it will be found that fortunately for the patient, "total" removal of the prostate gland has not been accomplished. In order to realize exactly what has been accomplished, the information gained in the operating theatre should be contrasted with the morbid anatomy commonly met with in cases of this disease, that have died without operation and compared with the features seen in complete sections made of the tissue removed and of sections made of the prostatic bed and adjacent viscera in cases that have terminated fatally after the operation.

It is the experience of every surgeon who has performed the operation of suprapubic prostatectomy on several occasions to note the ease with which the large "adenomatous" hypertrophied prostate is frequently removed. The thin mucous

FIG. 41.



Enlarged prostate forming intravesical projection. Note trabeculation of bladder from extreme muscular hypertrophy with diverticulum and dilatation of ureter.



membrane covering the mass projecting into the bladder is scratched through without difficulty. The line of cleavage is easily found. The finger sweeps readily round the mass of tissue which is enucleated with celerity and in comfort, being held for an instant only when the tough mucous membrane of the urethra is being torn through. The bleeding at the time is in no way alarming, and is soon naturally controlled. The cavity or prostatic bed out of which the tissue has been extracted contracts at once to a size approximately half of that of the structure it previously contained. The prostatic bed is felt to possess a smooth lining and the inner vesical sphincter can be made out as a muscular ridge between the bed below and the vesical cavity above.

When the morbid anatomy of such a case dying without operation is examined, it will be noticed how nature would here appear to have designed the parts for the performance of suprapubic prostatectomy.

The main bulk of the gland forms an intravesical projection covered by a thin and atrophied mucous membrane (Fig. 41). The internal vesical sphincter is dilated and crushed into a region of safety and surrounds the base of the intravesical mass (Fig. 21). Damage to it is virtually impossible.

The line of cleavage between the false capsule formed by the condensed uninvolved prostatic tissue and the diseased lobes is distinctly defined by the flattened and atrophied gland acini which form the ring of "postage stamp" perforations that have already been described in referring to the morbid anatomy of the disease (Fig. 23). The process being confined to the middle and lateral lobes, the ejaculatory ducts and posterior lobe are displaced into a region of safety and are separated from the area of hypertrophy by the thick-walled, false capsule. This latter membrane also serves as a thick protecting coat to the large blood sinuses lying between the sheath and true capsule (Fig. 24). The external vesical sphincter is also safe from any possible source of damage.

When the tissue removed in such a case is examined it will be noticed to possess the typical appearances of prostatic hyper-

trophy or chronic lobular prostatitis already described (Figs. 42-44).

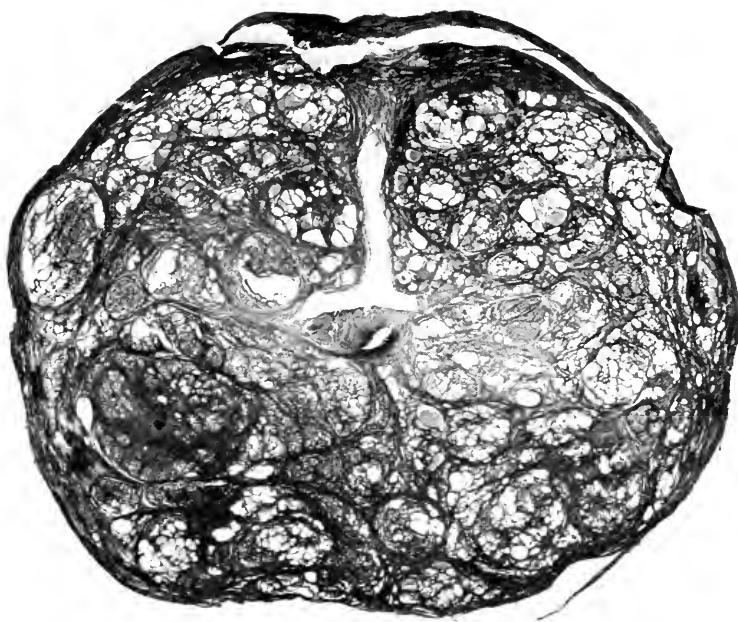
Serial sections never reveal the presence of the ejaculatory ducts within it or of striped muscle fibres coating the specimen.

A fatal issue may ensue even in such a case, however, and a further opportunity be afforded of observing what the operation accomplished locally. In order to investigate this latter question, I have studied the pathology of eight fatal cases following prostatectomy. The pelvic viscera were hardened *in situ* and thereafter complete celloidin sections of the prostatic bed and adjacent viscera were made and examined microscopically. For our present purpose, one typical case will be referred to.

The case was that of a man who suffered from typical prostatic dysuria from prostatic hypertrophy. The gland was extracted without difficulty. He died, however, on the fifth day from pelvic cellulitis, owing to infection through the space of Retzius. Fig. 45 is a vertical median (sagittal) section traversing the prostate and prostatic urethra which was removed. Fig. 46, a similar section of the prostatic bed left after removal. Fig. 47 is a composite superimposed photograph with the gland replaced within the cavity from which it was extracted by operation. Owing to the contraction of the cavity of the prostatic bed, the photograph of the prostate had naturally to be reduced in size to permit of this. When Fig. 46 showing the prostatic bed is examined, it will be noticed that the stretched internal vesical sphincter surrounds the upper vesical entrance to the cavity. The thick, smooth covering of the false capsule lining the space is visible. Microscopic examination shows this coat to consist of condensed prostatic tissue, consisting mainly of muscle fibres and fibrous strands with compressed and atrophied gland acini amidst the fibres. The ejaculatory duct is clearly shown traversing the posterior wall of the space from the seminal vesicles above. Below and behind the ejaculatory ducts, the compressed and atrophied posterior lobe is seen lying between the false capsule and space of Denonvillier.

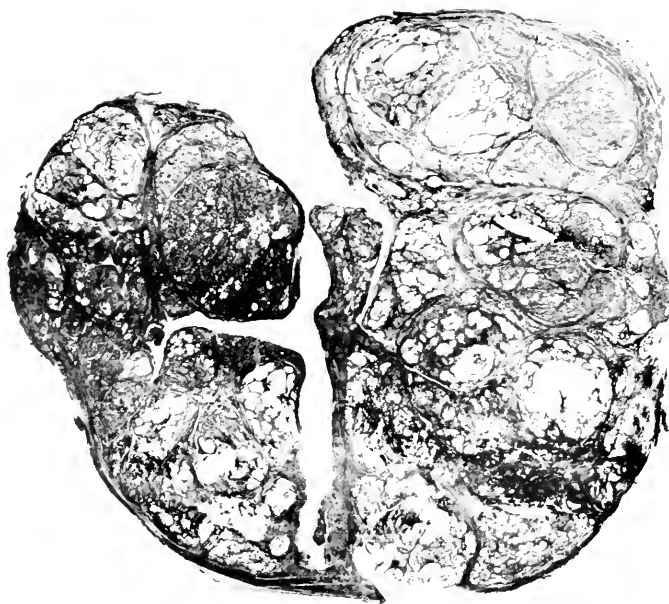
The undamaged external vesical sphincter and recto-urethralis muscles are seen beneath the prostatic bed. Fig. 47, where the tissue is superimposed within the cavity from which it was ex-

FIG. 42.



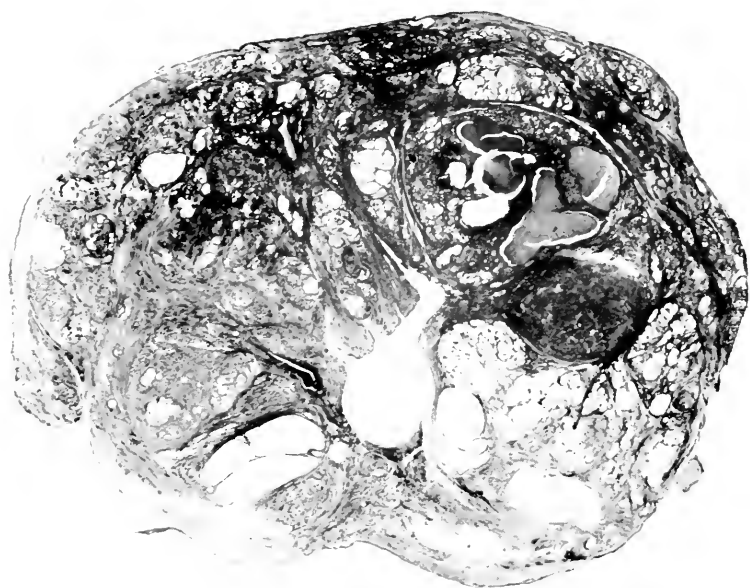
Horizontal section of prostate removed by suprapubic prostatectomy for chronic lobular prostatitis (prostatic hypertrophy), showing disease to be generalized and portions of false capsule.

FIG. 43.



Horizontal section of prostate removed by suprapubic prostatectomy for chronic lobular prostatitis (prostatic hypertrophy) showing numerous thin-walled retention cysts where disease is advanced.

FIG. 44.



Horizontal section of prostate removed by suprapubic prostatectomy showing advanced chronic lobular prostatitis (prostatic hypertrophy) with numerous large retention cysts.

FIG. 45.



Median sagittal section, prostate, removed by suprapubic prostatectomy, "total" enucleation for chronic lobular prostatitis (prostatic hypertrophy). Note section traverses prostatic urethra and shows thin mucous membrane covering middle lobe.

FIG. 46.



Median sagittal section of prostatic bed from patient dying on the fifth day after suprapubic prostatectomy, "total" enucleation, showing dilated internal vesical sphincter, thick false capsule, conservation of ejaculatory ducts, posterior lobe and external vesical sphincter. (Figs. 45 and 46 from same case.)

FIG. 47.



Suprapubic prostatectomy, "total" enucleation, superimposition photograph made from Figs. 45 and 46, the prostate being replaced within the prostatic bed.

FIG. 48.



Sagittal section of prostatic bed in midlateral plane showing situation and structure of false capsule lining prostatic bed and relationship of seminal vesicles and posterior lobe.

FIG. 49.



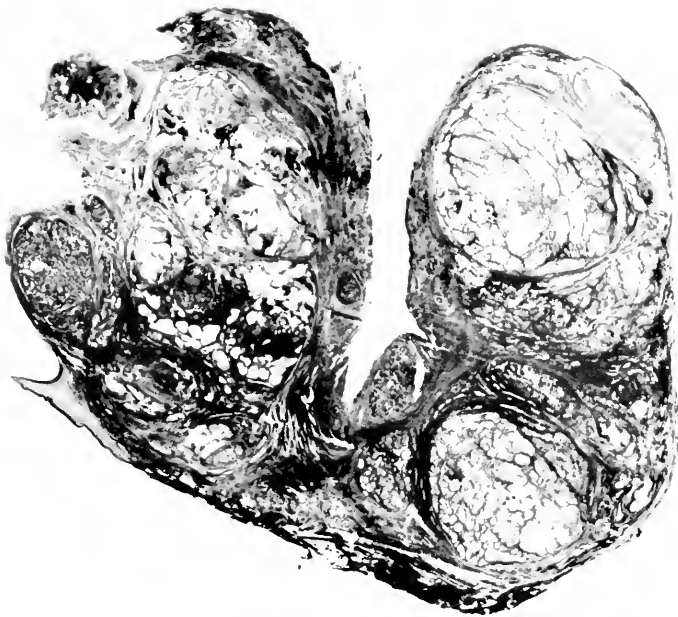
Lateral sagittal section from previous case, Fig. 46, showing margin of prostatic bed with nodules of diseased prostatic tissue within false capsule.

FIG. 50.



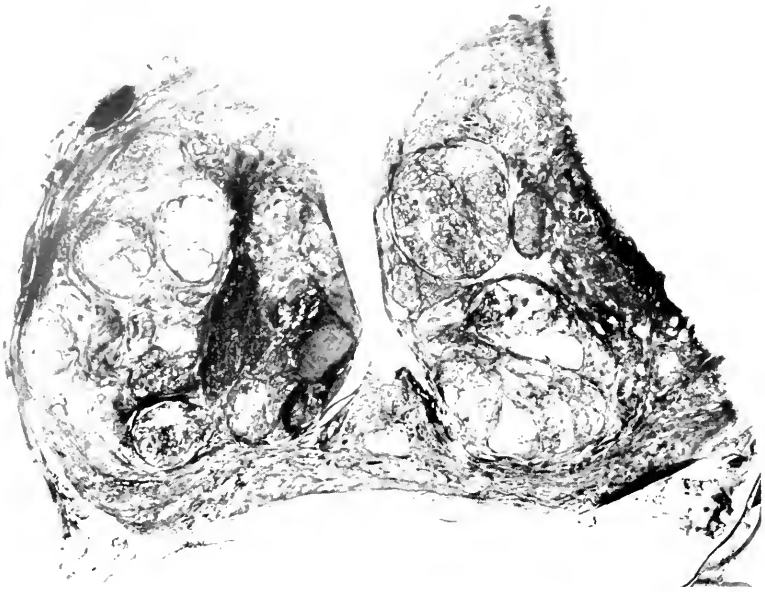
Lateral sagittal section from previous case, Fig. 46, showing prostatic bed containing nodules of diseased prostatic tissue within false capsule and relationships of internal vesical sphincter, seminal vesicles, and posterior lobe.

FIG. 51.



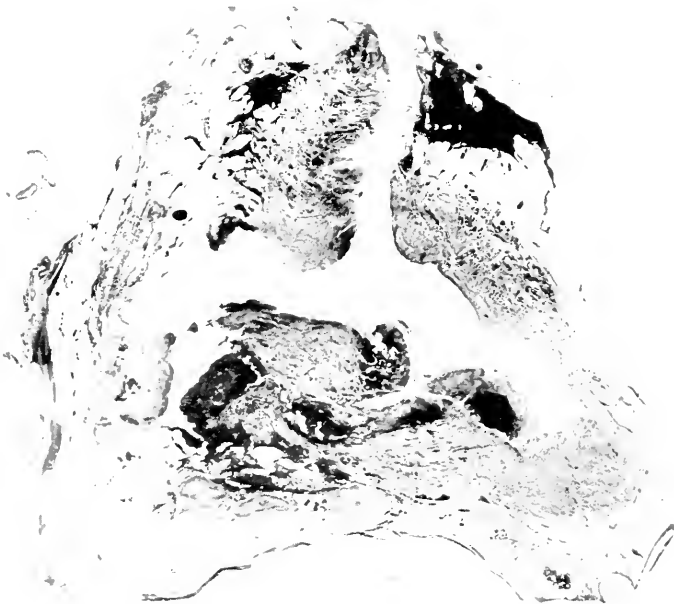
Horizontal section, prostate, removed by suprapubic prostatectomy for chronic lobular prostatitis (prostatic hypertrophy), showing partial conservation of prostatic urethra.

FIG. 52



Horizontal section, prostate, the site of chronic lobular prostatitis (prostatic hypertrophy), showing nodular spheroidal nature of overgrowth and formation of false capsule. (P.M. Specimen.)

FIG. 53.



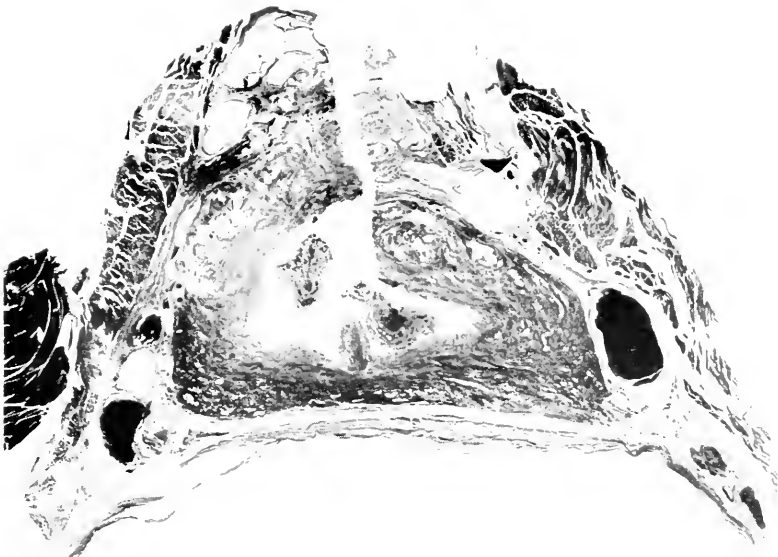
Horizontal section of prostatic bed, seminal vesicles, and rectum after suprapubic prostatectomy showing lateral wound in false capsule communicating with extracapsular lymph space. (Upper incision made at post mortem.)

FIG. 54.



Horizontal section of previous case at lower level showing false capsule, posterior lobe and conservation of ejaculatory ducts.

FIG. 55.



Horizontal section of previous case, showing prostatic bed, thick false capsule, posterior lobe and relationship of blood-vessels to prostatic sinus.

FIG. 56.



Sagittal section of prostatic bed, rectum and urethra after suprapubic prostatectomy showing false capsule and portions of tissue remaining after nodular removal.

FIG. 57.



Vertical section of tissue adherent to apex of prostate removed by suprapubic prostatectomy (Fig. 31), showing urethra and portions of external vesical sphincter.

FIG. 58.



Coronal section of lateral wall of prostatic bed after suprapubic prostatectomy, showing thick false capsule containing numerous septic thrombi.

tracted, conveys in a manner more lucid than verbal description, the exact nature of the operation, where a "total" enucleation of the prostate gland is accomplished by the operation of suprapubic prostatectomy.

Even in the case above described, serial sections showed that, at the margin of the lateral lobes, nodules of diseased prostatic tissue had remained behind within the false capsule (Figs. 48-50).

2. *Total Enucleation with Conservation of the Prostatic Urethra by Suprapubic Prostatectomy.*—The determining factor in this operation is the consistence of the anterior commissure. Where there is situated in front of the urethra a mass of tissue tough in consistence and virtually devoid of disease, the finger is deflected naturally toward the urethra as it passes over the front of the gland and sweeps behind the urethra conserving it wholly or in part in consequence.

In such cases, it will usually be found that the lateral lobes are not widely involved in the disease which is mainly confined to the middle lobe.

Horizontal sections of specimens from such cases show a typical horseshoe contour (Fig. 51).

3. *Lobar Enucleation.*—The nature of the false capsule formed by the disease is the determining factor in such cases. In those cases where the morbid process is more lobar than lobular a thick false capsule surrounds the lobes and their separate enucleation is most easy and most likely to be accomplished (Fig. 22). The appearance in sections of the tissue removed is characteristic (Fig. 35).

4. *Nodular Enucleation.*—The nature of the false capsule is here again the determining factor in explaining the result achieved.

In discussing the morbid anatomy of prostatic hypertrophy or chronic lobular prostatitis, it was pointed out that the change that led to the formation of the false capsule surrounding the gland was not confined to that region, but took place in a similar manner between individual spheroids. In those cases where the tissue removed is extracted in individual nodules

of varying size, it will be observed that the external false capsule is imperfectly formed and the finger is in consequence deflected into the lines of separation that pass into the gland and separate the individual spheroids (Fig. 52).

It has already been mentioned that in addition to the case already described, the pelvic viscera of seven other cases that died after the operation of prostatectomy were hardened *in situ* and serial sections made of the prostatic bed and neighboring viscera. Certain of these illustrated some of the complications with which the operation may be associated.

Fig. 53 shows a traversed section of the parts left after removal and shows fragments of diseased prostatic tissue that have remained adherent to the false capsule, and illustrates how the false capsule had been lacerated at the time of operation and the space between the true capsule and sheath opened into. The effect of this was shown at the post-mortem examination in the large amount of extravasated blood that had infiltrated the pelvic cellular tissue, extending up over the posterior surface of the bladder into the retroperitoneal connective-tissue planes. The patient died from pelvic cellulitis, the infecting bacteria having gained entrance through the torn false capsule.

Sections from the same case (Fig. 54) at a lower level show the manner in which the ejaculatory ducts are conserved and come to open into the large prostatic bed. It also demonstrates the posterior lobe that remains after removal, lying between the ejaculatory ducts and the space of Denonvillier, and how in this case large parts of the lateral lobes were similarly uninvolved by the disease, and remained behind after enucleation.

A further section from this case made at a still lower level (Fig. 55) demonstrates the relationship of the blood-vessels in the sheath after prostatectomy, showing how they are protected by the thick layer forming the false capsule and the uninvolved prostatic tissue.

In only one of the eight cases examined were the ejaculatory ducts found to be seriously damaged. In five of the eight, the false capsule was torn and the pericapsular space infiltrated with blood and infected.

The appearances seen in one case, where a nodular removal was practised are illustrated in Fig. 56. Numerous fragments of diseased prostatic tissue have been left and are seen projecting into the prostatic bed. In such a class of case, it is not difficult to account for the liability for the obstruction to recur after the operation is recovered from.

Microscopical examination of the prostatic bed of the eight cases showed it to consist of muscle and fibrous tissue and compressed gland acini as already described and in all cases it was the site of an acute suppurative process. In all cases, small septic thrombi were present in the smaller vessels and in two cases large septic thrombi were also present in the large veins of the prostatic sinus (Fig. 58).

The question may now be considered whether a total extracapsular complete enucleation of the prostate gland is ever accomplished by blind finger dissection in the course of the operation of suprapubic prostatectomy. In certain anatomical text-books, the student is led to believe that this is what the surgeon aims at and usually accomplishes.

Thus, for example, the most popular student text-book of anatomy states:

Immediately surrounding the prostate, and quite independent of the sheath, is the fibrous capsule of the prostate. This capsule varies in thickness, in some cases being extremely thin, in others forming a distinct cortex. In association with operations for the removal of the prostate now frequently performed, it is important to notice that the capsule has but very slight connection either with the venous plexus or with the sheath of pelvic fascia. It is on this account, that the gland can be so easily shelled out from its surroundings.

So far, I have only obtained one specimen of this nature. It was presented to me by a graduate, and in addition to the complete prostate, the seminal vesicles had been removed along with portions of the vasa deferentia, which hung like tentacles to the specimen. When the specimen was sectioned, it showed the gland to be the site of chronic interstitial prostatitis. I was informed that it was removed with the utmost difficulty. This was not surprising. No further history was obtainable.

Cases are, however, not rare where a partial extracapsular removal has been carried out. In the operating theatre, these are difficult cases, and when the specimen is examined after removal portions of striped muscle fibre are found on its surface, and a portion of one of the veins of the prostatic sinus may be adherent (Fig. 31).

From the lower apex of the gland, a tongue of tissue fre-

quently projects which contains muscle fibres derived from the external vesical sphincter (Fig. 57). These are usually either cases of diffuse chronic lobular prostatitis, where no spheroids are formed, or combined lobular and interstitial prostatitis, or, as in Fig. 31, cases of early carcinoma. The case from which this last specimen was obtained terminated fatally, and the post-mortem examination showed the false capsule to have been torn, and early secondary carcinoma present in the lymphatics.

I have not had the opportunity of examining post mortem a case of fibroid prostatitis treated by prostatectomy. If, in such a case, the prostate is enucleated, it is easy to deduce what is likely to result from what has been already described as the morbid anatomy of this disease.

THE LOCAL RESULTS OF PROSTATECTOMY—CONSERVATIVE PERINEAL OPERATION OF YOUNG.

In discussing the results of Young's operation, the surgeon has the advantage in that, he is afforded at the time of operation a full view of the dissection he executes, consequently, the same dubiety as to the structures divided and removed does not exist. The material examined by me was obtained from ten cases all of which were operated on by myself. When the tissue removed was sectioned and examined microscopically it showed the lobes to be masses of tissue, the site of chronic lobular prostatitis, and demonstrated the fact that the lobes were the product of no natural anatomical division of the gland but resulted from the separation of a common mass of diseased tissue into three more or less artificial divisions.

THE CHOICE OF OPERATION BASED ON THE PATHOLOGY OF THE DISEASE WITH ESPECIAL REFERENCE TO THE RELATIVE ADVANTAGES OF SUPRAPUBIC AND PERINEAL PROSTATECTOMY.

In discussing this question, we are met at the outset by the opinion already expressed when considering the pathology of certain "ideal" cases of advanced chronic lobular prostatitis,

where it was said that nature would appear to have designed the parts for the operation of suprapubic prostatectomy. We will therefore consider the question from three stand-points: (1) The factors contributing to the relatively high mortality met with in those "ideal" cases, when treated by suprapubic prostatectomy and how far it is possible to diminish this by the employment of other methods of operative treatment; (2) the local complication that may follow recovery after suprapubic prostatectomy in "ideal" cases of prostatic enlargement; (3) the danger of attempting to perform Freyer's operation of suprapubic prostatectomy in cases where the circumstances are not "ideal," the prostatism being due to other causes.

When the first question is considered, the facts concerning the cause of death after suprapubic prostatectomy already mentioned should be borne in mind. It has been already shown that the "ideal" case was the large "adenomatous" hypertrophied prostate, the site of chronic lobular prostatitis, where a large intravesical projection existed and a thick complete false capsule was formed. The damage to the patient's health during the period when this mass of tissue was ripening for removal has been also shown; the local and general irreparable damage caused by the prolonged backward pressure on the bladder and kidneys due to the retention of urine have been described. The case may be "ideal" for suprapubic prostatectomy, but the health of the patient has become so permanently impaired that any operation is now to him a most dangerous procedure.

The factors, that are liable to be the immediate cause of death in such a case have been shown to be (1) local infection arising out of the wound inflicted, for example, pelvic cellulitis, suppurative cystitis, consecutive suppurative nephritis and under this heading may be included also reactionary hemorrhage; (2) the development of a distal septic focus such as bronchopneumonia; (3) embolism, producing pulmonary infarction which is always due to an associated infection; (4) surgical accidents, such as fatal reactionary hemorrhage and

peritonitis; (5) uræmia. In cases, where the damage to the kidneys before operation was so severe, that, in the absence of other complications, this revealed itself as the sole cause of death.

The underlying cause, common to all, is thus the weakened power of resistance owing to the prolonged disease.

The dangers that are peculiar to suprapubic prostatectomy in an "ideal" case are the wounding of the space of Retzius and the consequent risk of septic pelvic cellulitis and the risk of pulmonary infection with hypostatic congestion and pneumonia that is present when an elderly patient is confined to bed for some time as is the general practice after suprapubic prostatectomy. The third risk is the difficulty of providing an efficient drainage of the bladder and prostatic bed so as to prevent a profound septic absorption from the stagnant septic urine that bathes the raw surface of the latter.

We may now ask how far these factors are avoidable by the choice of other means of treating the disease. The choice at our disposal lies between catheter life, the performance of a preliminary suprapubic cystotomy, and perineal prostatectomy. Catheter life may be dismissed at once as only justifiable in the hopelessly inoperable cases of this type. Preliminary suprapubic cystotomy is favored by some on the grounds that it permits of a certain improvement in the patient's condition prior to the removal of the growth and improves the condition of the septic bladder; but the value of it is doubtful. Page has shown how the mortality attending this line of treatment is relatively as great as that attending suprapubic prostatectomy and it has further this disadvantage, that it does not get rid of the main risk of the operation where suprapubic prostatectomy is performed in an "ideal" case, which is pelvic cellulitis due to infection by way of the space of Retzius.

A typical case is quoted below to illustrate this danger.

He was a man of sixty-seven, upon whom a suprapubic cystotomy was performed with the intention of its being preliminary to a suprapubic prostatectomy. On the night after operation, the

temperature rose to 103° and remained high for nine days, when it fell to 100° F. He complained chiefly of pain in the upper part of the abdomen, and died suddenly on the tenth day. The abstract of the pathological record is: Enlarged prostate, backward pressure, pyelitis, pelvic suppurative cellulitis, early bronchopneumonia. The detailed description of the pelvic viscera shows how the pelvic cellular tissue was infiltrated by a thick, greenish lymph which extended up into the retro-abdominal tissues. This area of purulent infiltration extended from the space of Retzius which had been wounded in the natural course of opening the bladder. The purulent infiltration reached as far as the lower pole of the right kidney. The prostate was increased in size, with a nodule of prostatic substance projecting into the cavity of the bladder behind the urethral opening and forming the so-called middle lobe of the prostate. This projection was covered with ulcerating bladder mucosa. The bladder wall was hypertrophied owing mainly to an increase in the muscular coat. The mucous membrane had undergone chronic ulceration and multiple villous-like projections of indurated mucous membrane projected from the surface. The ureters were somewhat dilated, their walls were hypertrophied, and their mucous membranes showed evidences of recent catarrh. The pelves of both kidneys were dilated and showed signs of recent acute catarrh. There was no evidence of suppurative nephritis; there was some chronic interstitial nephritis.

Where perineal prostatectomy according to Young's method is employed for the treatment of this "ideal" case it is of course associated with risks peculiar to itself, but with it there is naturally no risk of infection of the space of Retzius which is not damaged. The risk of pulmonary complications is much less, the patient being out of bed on the second or third day, and finally, every impartial critic will grant that where the technic of bladder drainage is carried out according to the directions laid down by Young, the drainage is as near "ideal" as is possible to achieve and there is no retention of stagnant septic urine in the bladder and prostatic bed.

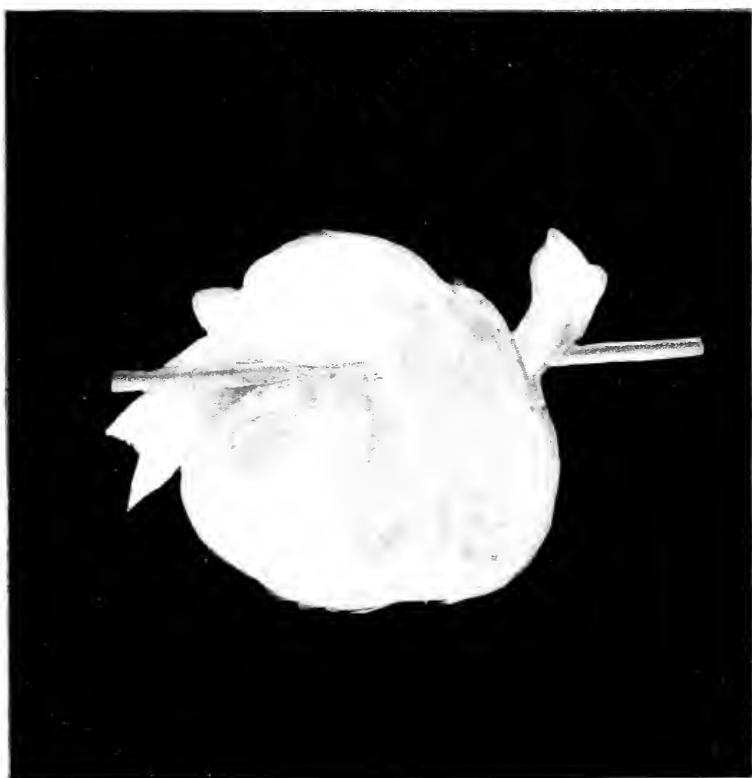
The unavoidable risks peculiar to Young's operation in such a case are the greater length of time occupied by the

operation and the risk of infection of the pelvic cellular tissue planes owing to the opening of the lymph paths when the space of Denonvillier is opened into. This latter would appear, however, to be more a theoretical than actual danger as it has not been encountered by Young in his numerous cases and in my very limited experience of ten cases it has never been encountered. The reason for this would appear to be that the time when infection is liable to gain entrance to the cellular tissue is during the hours immediately following the infliction of the wound before nature has had time to create the natural protective barrier, and during this period in Young's operation the bladder drain and gauze packs in the prostatic bed prevent the entrance of septic urine in such quantity as to lead to a cellulitis. When the gauze packs and bladder drain are withdrawn by the end of the second day the free dependent drainage prevents septic material accumulating. The importance of this latter fact appears to me to be borne out in my limited experience where I have noticed how liable such patients are to have a slight rise of temperature and other indications of ill health about the end of the first week after operation; at that period when the external skin wound is closing but still a day or two before the urine comes by the natural channel. During this brief interval Denonvillier's space is liable to be distended with septic material for the first time during the course of operation. This passing phase of septic absorption, if my explanation be correct, bears out the well-known surgical dictum, "That man does not die from sepsis on a free surface, it is the confinement of sepsis that the surgeon fears after operation."

The avoidable risks peculiar to perineal prostatectomy are probably more dreaded by certain surgeons. The reality of them no one familiar with the operation will gainsay. None of them are, however, such as to be likely to lead to a fatal issue.

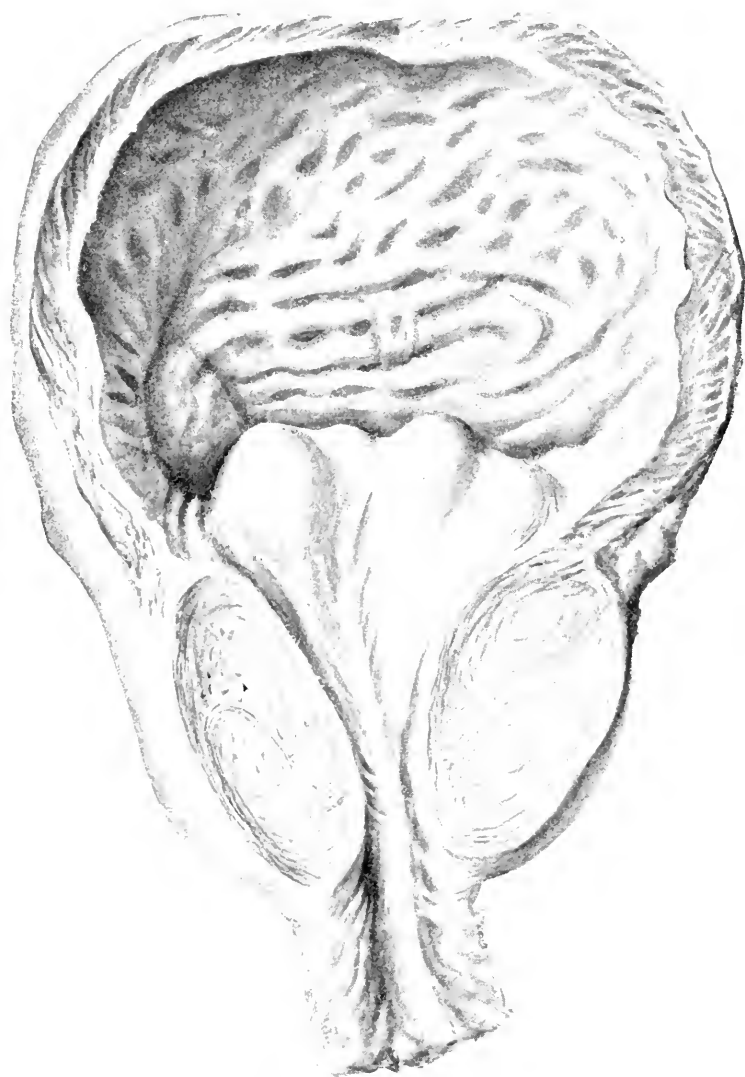
A "total" enucleation of the gland along with the prostatic urethra can, of course, be accomplished by perineal prostatectomy and blind finger dissection in the "ideal" case (Fig. 59). To accomplish this the integrity of the floor of the

FIG. 59.



Prostate removed by perineal prostatectomy, "total" enucleation along with prostatic urethra.

FIG. 60.



Bladder and prostate showing prostatic hypertrophy, intravesical herniation with displacement of internal vesical sphincter.

prostatic bed must be destroyed and Denonvillier's space with its contained lymphatics opened. This operation possesses those advantages that a perineal cystotomy does over a suprapubic cystotomy. Where a median incision is employed and the case found to be one that does not permit of the gland being enucleated by the unaided finger the surgeon may enlarge the wound and excise the gland by visual dissection. The operation has certain obvious disadvantages. The confined space necessitates a longer and more difficult operation. The external vesical sphincter of the prostatic bed must be damaged. Denonvillier's space is opened as an unguarded path of infection. The only advantage it possesses over Young's operation is a wound that is slightly smaller and an operation that is slightly more expeditious. On the other hand, the damage that may be produced by blind dissection in this region is necessarily very much greater than is the case where the dissection is executed by sight. On these grounds, I do not think it necessary to refer further to it as, where the perineal route is employed, Young's operation will be found in all cases to be the best to employ.

II. THE LOCAL COMPLICATIONS FOLLOWING RECOVERY AFTER PROSTATECTOMY IN "IDEAL" CASES OF PROSTATIC ENLARGEMENT.

The complications that are usually considered as liable to occur are:

(1) *Incontinence of Urine*.—This is considered to be especially liable to follow perineal prostatectomy. Young, however, has not had one case of complete incontinence after operation. He has had three cases of troublesome diurnal incontinence and four of nocturnal incontinence. It is considered as less likely to follow suprapubic prostatectomy and from what we have already seen such is naturally to be expected. McDonald in his analysis of the cases operated on in St. Peter's Hospital mentions three cases. In none did permanent incontinence remain. If suprapubic prostatectomy is combined with perineal drainage permanent incontinence may

develop. Fullarton has recorded such a case. The risk in such a case lies in the destruction of the dual sphincter that guards the bladder in a manner we have already seen. In citing those statistics, it is only fair to remember that many of the cases were not of the "ideal" type of disease that we are at present considering.

(2) *Return of Obstruction*.—This is usually due to incomplete removal of the disease and may develop in any case. Where the circumstances are ideal for suprapubic prostatectomy and the whole area of disease in consequence removed, the likelihood of this occurrence is most remote. It is, if anything, more likely to follow perineal prostatectomy in such cases.

(3) *Loss of Sexual Power*.—This is considered as especially prone to develop after perineal prostatectomy and is accounted for by the damage to the ejaculatory ducts. If these are conserved and the zone on the floor of the urethra and around the verumontanum preserved it can be avoided. This danger may be considered to be non-existent where suprapubic prostatectomy is performed in an "ideal" case. We have seen how nature in such cases carefully protects the ejaculatory ducts and verumontanum from damage. It is even claimed that the sexual vigor may be increased after suprapubic prostatectomy in certain cases and when the relief from pressure on the seminal ducts that follows the operation is realized, it will be apparent that this claim is quite rational.

(4) *Persistence of Vesical Fistula*.—This may occur in either operation. It is probably more common in the perineal operation.

(5) *Epididymitis*.—This would appear to be more common after suprapubic prostatectomy. McDonald examined 118 such cases, 14 of these suffered from epididymitis prior to operation, 27 developed it in hospital after operation. In 4 it arose after leaving hospital, a percentage of 27.75. The explanation of the relatively greater frequency of this complication in suprapubic prostatectomy would appear to be the less efficient drainage that is the rule with this operation.

(6) *Formation of Calculi in Bladder or Prostatic Pouch.*—

This is a complication that occasionally arises. Its relative frequency after suprapubic or perineal prostatectomy is uncertain.

(7) *Recto-Urethral Fistula.*—This serious complication is especially liable to arise after a perineal operation. Its possible occurrence appears to have strongly prejudiced some surgeons against this route. It is by no means so common as is supposed. Young has observed it four times in 450 cases. Its prevention lies in a knowledge of certain anatomical relationships that have already been demonstrated.

The position as regards the operative treatment of the "ideal" case of prostatic hypertrophy due to chronic lobular prostatitis may therefore, be briefly stated to be that the simplest, most rapid, and, speaking broadly, the safest method of treatment is Freyer's operation. When it is performed, it is of the utmost importance that the skin wound should not be sutured so as to minimize the risk of prevesical infection. Efficient drainage of the bladder and getting the patient out of bed as early as possible are of equal importance.

Perineal prostatectomy in such cases, in skilful hands, may produce an equally good result, but is more liable to be followed by such post-operative complications as stricture, fistula, or partial incontinence. In the hands of those unfamiliar with the accurate steps of the operation and its after-treatment, it is a much more dangerous method of treatment for this class of case. Thus on practical grounds, we may reaffirm that nature would here appear to have designed the parts for the operation of suprapubic prostatectomy.

THE OPERATIVE TREATMENT OF CASES OF PROSTATISM WHERE
THE DISEASE IS NOT IDEAL FOR SUPRAPUBIC PROSTA-
TECTOMY.

We have seen how in this class there is included (1) cases of chronic lobular prostatitis or prostatic hypertrophy without glandular enlargement; (2) cases of chronic lobular prostatitis

without intravesical projection; (3) cases of chronic lobular prostatitis without the formation of a complete false capsule; (4) cases of chronic interstitial prostatitis where the disease is generalized, or has led to the formation of a median prostatic bar; (5) cases of carcinoma of the scirrhous type or involving the capsule.

The danger of attempting to perform Freyer's operation in such cases is known to every surgeon who has endeavored to do it. At the same time, it should be remembered that Freyer's position as regards such cases is perfectly clear. In speaking of cases suitable for suprapubic prostatectomy he says:

"In patients in the earlier stages of the malady in whom not more than an ounce or two is found on introducing the catheter, it is inadvisable to attempt the removal of the prostate because the enlargement of the organ will not have sufficiently advanced to render it prominent in the bladder or to define adequately the lines of cleavage between the true capsule of the prostate and its enveloping sheath. When we have to deal with adenomatous enlargements of smaller dimensions, say less than $1\frac{1}{2}$ ounces in weight, the greatest difficulties present themselves as to the possibility of their enucleation entire being practicable."

It is important to bear in mind, however, in addition to early cases with a smaller quantity of urine the most pronounced cases of prostatism with the severest degree of backward pressure are frequently met with in cases where the prostate is not enlarged or only slightly so and where the gland in consequence maintains its normal relationship to the surrounding structure.

In treating such cases, therefore, the courses open to us are (1) to delay and wait for the gland to ripen to the maturity necessary for the satisfactory performance of suprapubic prostatectomy, a procedure surely unwarranted as a sound surgical practice in the light of the damage done to the urinary tract and the whole body by delay; (2) to endeavor to enucleate the gland by suprapubic prostatectomy; (3) to

seek in another operation a satisfactory means of treating such cases.

The risks associated with the second course where suprapubic prostatectomy is practised in the types of disease mentioned are numerous and have been already referred to. Thus, in chronic interstitial prostatitis and advanced carcinoma the operation is practically impossible. Its attempted performance is advised by no surgeon of standing, but, at the same time, cases have occurred where it has been attempted and I have referred to one where a complete extracapsular removal of the entire gland was achieved by this means. The dangers of such a procedure are too obvious to warrant repetition.

Where glandular hypertrophy without intravesical projection is present, it can of course be diagnosed by cystoscopic examination, or better still examined with an urethroscope, such as Wossidlo's, or a cysto-urethroscope. I am afraid, however, that in many cases, it is only when the bladder is opened that the condition is discovered. Suprapubic prostatectomy in such a case necessitates damage and probably destruction to the internal vesical sphincter. It is likely also that in these cases the line of cleavage between the area of disease and false capsule will be more difficult to find. The result is, the operation is much more difficult and the extracapsular lymph space will probably be opened into and the grave risk of septic pelvic cellulitis encountered in consequence.

There remains last the case where the false capsule is imperfectly formed, to be considered. I claim to have already shown that these cases are occasionally met with and we have seen how when suprapubic prostatectomy is done in such cases the tissue is removed, usually in fragments with the risk of leaving portions as possible future causes of obstruction. In this class of case again the dangerous lymph area between the capsule and sheath may be opened into.

We may, therefore, consider that in all the classes of cases mentioned Freyer's suprapubic prostatectomy is unsuitable.

III. THE OTHER OPERATIVE PROCEDURES SUITABLE FOR THESE CASES.

Those comprise (1) perineal prostatectomy; (2) division of the median bar by Bottini's galvano-cautery, or its modifications, or by Young's more recently introduced prostatic punch; (3) suprapubic transvesical prostatectomy by the transperitoneal route or extraperitoneal with visual dissection.

The scope of the second variety of operative treatment where the cautery or punch is used is clearly defined. They are the procedures of choice for cases of chronic interstitial prostatitis, especially with median bar formation.

Perineal Prostatectomy.—Cases of chronic lobular prostatitis (prostatic hypertrophy) without glandular enlargement are particularly suitable for this operation. In this type of disease, the false capsule was well formed in the cases I have examined. The entire gland, however, is situated below the bladder floor and separated from that cavity by its mucous and muscular coats.

By means of the operation of perineal prostatectomy, if properly executed, the area of disease may be entirely removed without damage to the internal or external vesical sphincters. If, at the same time, the surgeon, following Young's instructions, cuts deeply into the individual lobes by the incisions made parallel to the course of the prostatic urethra the compressed tissue of the posterior lobe will be divided and the line of natural cleavage reached that allows of the easy removal of the diseased tissue in the separate portions described as lobes by Young. It has appeared to me that the importance of making this incision of a necessary depth in all cases where Young's operation is performed, so that the posterior lobe is divided completely, is perhaps not always fully appreciated when this operation is performed and it is rendered much more difficult in consequence owing to the natural line of cleavage not being reached by the shallow cut made.

Where perineal prostatectomy is done for cases of chronic

lobular prostatitis with general enlargement without intravesical projection or with an imperfectly formed false capsule the dual sphincter can always be conserved. The absence of the false capsule will of course render the removal more difficult, but as this is an operation whose technic is that of a visual dissection and not a blind finger enucleation, as in the suprapubic operation, this difficulty is not anything like so serious. Further, the wounding of the extracapsular lymph space which is liable to occur and was referred to as a serious complication in the suprapubic operation is not here of serious consequence, because, owing to the reasons already given, the space is not liable to the same degree of septic infection and the drainage it receives is so thorough as to mitigate against the risk of cellulitis arising from this cause. If the large veins beneath the sheath are wounded the bleeding vessel can be seen and controlled by ligature and serious hemorrhage thus prevented.

The treatment of carcinoma by perineal prostatectomy has been shown by Young to be possible even in those cases where the capsule and base of the bladder are invaded. If the tumor is adherent to the rectum behind, the risk of damage to the bowel is correspondingly very much increased. Young has removed the entire gland along with the seminal vesicles and a portion of the bladder floor, a procedure impossible by the suprapubic route. It is only fair, however, to remember when considering the treatment of prostatic carcinoma that in many cases the disease when early has been removed with ease by Freyer's operation. This has, however, been accomplished when the malignant nature of the growth was clinically unsuspected and, usually, owed its success to the co-existence of chronic lobular prostatitis, upon which the malignant process had supervened. This latter fact is a further reason for advocating early operative interference in all cases of prostatic dysuria and it does not directly influence the question of the treatment of the disease when clinically recognizable. I think most will agree that in the light of the pathology of prostatic carcinoma and the results obtained by Young, Willan's advice as given in his

recent article is unduly pessimistic, when he recommends that where a diagnosis of cancer of the prostate has been made clinically the performance of a radical operation for the removal of the disease is not to be recommended. When 20 per cent. of cases of prostatic enlargement or obstruction in old men are recognized as due to carcinoma such advice is surely unwarranted.

Suprapubic Transvesical Prostatectomy by the Open Method.—This method of treating prostatic disease is being more generally practised in recent years. It is possible that when visual accurate dissection has replaced blind enucleation an "ideal" operative technic for the treatment of the above varieties of prostatic disease may be elaborated by this route.

Accurate removal and perfect control of hemorrhage would thus be possible. On the other hand, however, it is obvious that if the route is transvesical it must necessitate serious damage to the bladder in many cases to reach an organ that is frequently entirely extravescical in situation. How far this can be made good by reparative plastic surgery as a final procedure in the technic of such an operation can only be conjectured.

The conclusions as regards the treatment of prostatism from the stand-point of the pathology of the diseases causing it appear to me to be:

1. Three outstanding varieties of disease lead to prostatism: (*a*) Prostatic hypertrophy or chronic lobular prostatitis; (*b*) prostatic fibrosis or chronic interstitial prostatitis; (*c*) prostatic carcinoma.

2. The first is by far the commonest cause of prostatism and was present in 82 per cent. of the specimens examined.

3. Chronic lobular prostatitis is in my opinion a senile hyperplasia, an aberrant overgrowth of tissue that is not the result of the appearance of an independent new growth, but is liable to develop into the same.

4. Chronic lobular prostatitis in the majority of cases produces prostatic hypertrophy.

5. It virtually always develops in the middle lobe and is almost uniformly confined to the middle and lateral lobes.

6. The gland in consequence undergoes changes that usually permit of its easy removal by suprapubic prostatectomy.

7. Chronic lobular prostatitis may develop in and be confined to the anterior lobe, this being noted by me in one case.

8. Chronic lobular prostatitis may cause prostatism without enlargement of the organ, intravesical herniation or complete false capsule formation.

9. In these cases the performance of suprapubic prostatectomy is difficult and dangerous.

10. The successful performance of suprapubic prostatectomy depends on the presence of an advanced type of prostatic hypertrophy due to chronic lobular prostatitis.

11. The recognition of this is clinically frequently very difficult.

12. When a patient with this advanced type of disease is operated on his urinary tract and general health have usually suffered serious damage from the disease.

13. It is therefore unjustifiable to delay operation in an early case of chronic lobular prostatitis in order to permit of the gland undergoing those hypertrophic changes that facilitate its easy removal by suprapubic prostatectomy.

14. The mortality attending suprapubic prostatectomy is mainly due to the impaired health of the patient prior to operation.

15. The actual cause of death in such cases is usually a local infection arising out of the wound inflicted.

16. The operation of suprapubic prostatectomy by blind enucleation is unsuitable in cases of prostatism due to other causes than advanced chronic lobular prostatitis.

17. Perineal prostatectomy is a most suitable operation for such cases.

18. Perineal prostatectomy permits of the removal of the disease when its presence is diagnosed in all cases. It is, therefore, at present the operation that offers the best prospect of further advance in the treatment of prostatism.

19. For its successful performance an accurate knowledge of the anatomical structure and relationships of the prostate are necessary as well as an understanding of the pathology of the disease.

20. The suprapubic transvesical method of prostatectomy by visual dissection offers the prospect of developing into a method of treating prostatism that may ultimately warrant its adoption in a large number of cases.

21. Chronic interstitial prostatitis is best treated by division and removal of the constriction by the transurethral route.

22. Prostatic carcinoma may be in an early case clinically indistinguishable from hypertrophy due to chronic lobular prostatitis.

23. This fact is therefore a further reason for early operation in all such cases.

24. Prostatic carcinoma when recognized clinically may be successfully treated by excision of the gland in suitable cases.

I desire to record my gratitude to the President and Fellows of the Royal College of Surgeons of Edinburgh, in whose laboratories this research was conducted.

I wish to thank also many of my senior colleagues, and especially Mr. David Wallace, for permitting me to use material from their private and hospital cases, and Dr. Shennan and the staff of the Pathological Department of the Royal Infirmary of Edinburgh, for the many willing services they have done for me in the course of this investigation.

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SUPRAPUBIC VERSUS PERINEAL PROSTATECTOMY.*

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FOR relief from distressing symptoms and imminent peril, few operations can rival the successful removal of the enlarged prostate obstructing the urinary outlet. The dangers and disadvantages of catheter life are well understood. The average expectancy of life for those entirely dependent upon the catheter has been estimated at two and a half years. Squier has recently reported 17 cases in his own observation who were dependent upon the catheter. Of these, 14 had died with an average duration of life of two years and ten months after commencing catheter life. Twelve of these died from suppurative renal lesions.

This only bears out the fact that catheterism, even as performed at present in the full knowledge of the dangers of infection and the means of prevention, is an exceedingly risky state and should cause us to ask the sharp question whether the man who still advises the catheter in this condition should be ranked truly as a conservative or as a dangerous radical. Even granting a mortality of four to ten per cent. in the operation of prostatectomy, the average expectancy of life under operation greatly exceeds three years. Freyer recently had the satisfaction of seeing three of his first four cases of complete prostatectomy alive and well at the end of eleven years. The great difficulty with the catheter life is the possibility, in any but the exceptional case, of observing the necessary precautions to prevent infection of the bladder.

The cleanest catheterization *may* result in bladder infection;

* Read before the Baltimore City Medical Society, December 2, 1913.

dirty catheterization *is almost certain* to do so. In spite of all this cases are known to have lived for 15 to 20 years or more after beginning the use of the catheter. These are the exceptions which prove the rule. I have now a case under observation who has complete retention of urine. He is a man over seventy-five years of age, and otherwise in robust health. Since his first attack of complete retention fifteen months ago, he has been entirely dependent upon an indwelling catheter which is changed once a week. He suffers practically no inconvenience, urination being at normal intervals and controlled during the meantime by a cork in the catheter. The catheter is replaced each week by a physician, the greatest care being exercised to prevent the introduction of infection. The bladder is irrigated once a week with a solution of protargol. For anyone who has a urethra tolerant to a permanent catheter as well as the time, means and patience to carry out this treatment this appears to be as safe a form of catheter life as can be devised, though the time is yet too short to say that it has fully justified itself and in any event, such scrupulous care is beyond the range of possibility for the average patient. It is much like the rich man with duodenal ulcer or gall-stones. He can carry out the rest treatment or visit Carlsbad and take the Sprudel for nine medical cures before coming to the knife, while his less fortunate brother will be obliged to consult the surgeon at once.

Only a little over twenty years ago no one had removed or attempted the surgical removal of the entire prostate. A fair number of sporadic attempts had been made to remove the obstructing portion of the gland. In the earliest surgery of the prostate the acute question arose as to the best route of surgical approach. Belfield in America, Dittel in Germany and McGill in England, succeeded in partial prostatectomies through suprapubic incisions. Ferguson, Billroth and Gouley accomplished the same result through the perineum. I well remember Dr. Agnew in a discussion upon the relative merits of the suprapubic and perineal approaches to the bladder expressing his belief picturesquely by saying that "he never

could see the philosophy of breaking through the roof of a house when you could get in through the cellar door."

At about the same time, approximately twenty years ago, Goodfellow (1891) performed the first total perineal prostatectomy and Eugene Fuller (1894) removed the gland entire by the suprapubic incision. The immediate importance and success of complete prostatectomy intensified the strife as to method, the choice of route being the most discussed feature of the operation and in many cases, we fear, almost overshadowing the results of the operation itself. We are only now beginning to get the necessary perspective by which to value the operation and the various methods of its performance. We can discern three distinct swings of the pendulum, first, toward the suprapubic operation, second, toward the perineal route, and now again a very decided trend almost everywhere toward the suprapubic approach. Set over against each other as the protagonists of the two extremes we find Freyer, of London, confining himself to the suprapubic operation and Young, of Baltimore, adhering equally rigidly to the perineal method, the success of which owes so much to him in his development of the earlier methods of the Frenchman, Proust.

The most important single criterion by which an operation is to be judged is mortality. "All that a man hath will he give for his life." The safest surgery compatible with the attainment of the necessary object is the best surgery. If it can be shown that one or the other of these two rival operations possesses an undoubted superiority in the matter of safety then certainly the claims of the more dangerous operation must fall to the ground since it is conceded that the prostate can be enucleated by either method. The advocates of perineal prostatectomy have not been slow to take advantage of the mortality argument. Young's mortality in the latest report which I have seen was slightly over 4 per cent. Freyer in 1912 reported 1000 suprapubic operations with a total mortality of $5\frac{1}{2}$ per cent. Examining these statistics more carefully we find that Freyer was able to report in his last 100 cases only

three deaths, or a mortality of 3 per cent. Young at one time was able to report over 200 cases with a mortality of less than 3 per cent., but since then additional failures have raised the average until at the present time I believe it is fair to say that the mortality of the two operations, in the hands of their foremost exponents, is as nearly equal as it is possible to expect. Freyer was earlier in the field when the important factors of preliminary and after treatment were not so well understood as is shown by his earlier mortality of 10 per cent. for the first hundred cases. The combined statistics of operators throughout the world show a greater mortality for the suprapubic operation than for the perineal. Against this we must set the fact that the suprapubic operation is undoubtedly the easier and is therefore more often chosen by the operator of less experience. Also in the case of surgeons who perform both operations the easier is more likely to be chosen in desperate cases when a minimum of anæsthesia and manipulation is desired and in cases complicated by stone, which are admittedly subject to higher mortality.

In short it is my conviction, based upon personal experience and examination of the results of others, that the mortality of the two operations *per se* is approximately equal and that the factors influencing mortality are less to be sought for in the operation itself than in extraneous conditions, the most important of which are (1) the selection of the patient, either conscious selection on the part of the surgeon or unconscious, owing to the character of his practice; (2) to the preliminary preparation of the patient for operation; (3) to the skill of the operator, and finally, to rational after-treatment.

Second only to the mortality of operation is the question of the result of operation. Indeed, so wretched may be the condition of patients of this class either without operation or after an unsuccessful or complicated operation that the result may be said at times even to outweigh the question of life or death. Before the present era of comparatively satisfactory treatment of prostatism it was remarked by some one that the

victim of enlarged prostate often came to regard his last day as the best day of his life. Factors destructive of success in the restoration of function by operation are (1) incomplete removal of the obstruction, (2) the introduction of some other source of obstruction as a sequel of the operation itself, (3) loss of voluntary control of the bladder, (4) injury to the rectum, (5) persistent urinary fistula, (6) failure to recognize and treat complicating conditions, such as vesical calculus, (7) loss of sexual or procreative power in those who are still potent.

In the hands of competent operators incomplete removal of the obstructing organ is uncommon. With the suprapubic operation it is more difficult to leave behind an offending portion of the organ than by the perineal route. The portion of the prostate which most often causes trouble is most easy of access from above and is the portion first attacked and most certain of removal. The prostate is, in the vast majority of cases, removed entire, whereas in the perineal operation morcellation is more common and the most dangerous portion of the obstruction is the deepest seated, away from the eye and more likely to escape detection. While there are some who argue that the prostate is never entirely removed and that there is always some prostatic tissue left behind in the capsule, this does not make any particular difference as long as the patient gets well. Personally, I know that in all adenomatous prostates operated by the writer that the organ has been removed entire, with all due respect to the gentlemen who argue to the contrary. Squier reports a case in which a small portion of prostate was left by perineal prostatectomy, defeating the result of the operation and requiring suprapubic removal.

Occasionally the operation in removing the prostatic obstruction introduces some other obstructive element. Stricture of the damaged urethra or vesical outlet has been known to occur. In the perineal operation stricture is more likely to occur because of the traumatism to the membranous urethra. This portion of the urethra is not touched in the suprapubic

operation, but in perineal prostatectomy it is opened for the passage of the prostatic tractor in the case of Young's operation, or for the finger in the case of those who perform intra-urethral enucleation. A stricture of the lower urethra is more embarrassing to deal with than the contractions which occasionally occur in the prostatic portion, a complication to which the perineal prostatectomy is as liable as the suprapubic. In two cases of suprapubic removal I met with a complication requiring a second operation. This was obstruction of the urethral outlet by a flap of the torn mucous membrane made in the enucleation of the gland. Recovery was complete in both cases after excision of the flap of mucous membrane acting as a valve at the vesical orifice of the urethra.

Loss of voluntary control of the bladder after prostatectomy is an extreme disappointment to the patient inasmuch as it leaves his last state worse than his first. Here there is a very decided advantage in favor of the suprapubic operation. Voluntary control of the bladder is vested chiefly in the compressor urethræ muscle (external sphincter muscle), but partly in the internal sphincter (the aggregation of circular muscular fibres of the bladder at the vesical neck). It is obvious that any dissection of the perineum may occasionally inflict damage upon the compressor urethræ muscle or its innervation as well as upon the internal sphincter muscle, particularly through prolonged traction with a perineal tractor. On the other hand the compressor urethræ is in practically no danger in the suprapubic operation. The prostate lies entirely above the triangular ligament and it must be a very exceptional case or a very bungling operator that would injure the muscle, protected as it is by the triangular ligament.

The rectum is even more likely to be seriously injured than the compressor urethræ in the perineal operation. At the apex of the prostate and in relation with the membranous urethra, the rectum is held strongly forward by the recto-urethralis muscle and in some cases is almost directly applied to the urethra. The greatest care in dissection and the utmost gen-

tleness in handling is thus necessary to prevent wounding the bowel. No operator of large experience in perineal work has avoided this complication. Post-operative infection or pressure necrosis also have caused the rectum to be opened secondarily even when it was left intact by the dissection. The result of such an accident at best is perineal suppuration, protracted convalescence and often a rectovesical fistula. I have injured the rectum in perineal prostatectomy but never in the suprapubic operation, except in one small carcinomatous prostate with periprostatic inflammation, a case which should not have been operated on by the suprapubic method but by the perineal, if operated at all. This is the general experience and constitutes a valid criticism of the perineal approach.

The anterior fibres of the levator ani are attached to the sides and under surface of the posterior sheath and are likely to be injured to a degree, at least, in perineal enucleation, while not so in the suprapubic. The levator ani, like the voluntary muscles of the abdominal wall, assist in emptying the bladder, consequently it is important in any operation to inflict as little injury to the surrounding tissues as possible.

The urinary fistula left after both types of operation fortunately heals very kindly in the great majority of instances. It is well known, however, that suprapubic vesical fistulæ are more likely to close spontaneously than fistulæ in the perineum. In the suprapubic operation the course of the urethra is not disturbed, while in the perineal operation it is opened in order to gain access, either with finger or instruments, to the bladder. It is inevitable that such trauma of the urethra will at times result in stricture or fistula. I cannot but feel that this sequel is not as cheerfully acknowledged as should be by the perineal operators when it has occurred to me within a comparatively short time to have observed instances of persistent perineal urinary fistulæ, loss of control of the power of urination, the patient wearing a rubber receptacle tied to the thigh, coming from the hands of a man most prominently identified with peri-

neal prostatectomy whose writings would lead one to minimize, if not to dismiss altogether, this annoying sequel.

Partial or complete loss of voluntary control is by no means unheard of after the perineal operation while after the suprapubic operation it is certainly a most unusual sequel, if it occurs at all. I have had two patients who underwent perineal removal recently consult me for this unfortunate condition.

There is much less chance of failing to recognize intravesical conditions, particularly calculus, encysted stone and diverticula, with the bladder open for inspection by the suprapubic incision. Direct vision is preferable to even the most satisfactory cystoscopy. When I employ the suprapubic incision, unless the diagnosis is questionable, I rarely use a cystoscope, as I believe it is to many a marked addition to the burden of discomfort and unfavorable shock that they are called upon to endure. Exposing the interior of the bladder to the light of day dispels any mystery and reveals the truth.

Much stress has been laid upon the preservation of the sexual powers by Young's method of leaving the ejaculatory ducts. In many cases it makes little or no difference whether the operation be designed for this end or not, as the sexual powers have long since waned. In the minority of cases, other things being equal, it is desirable to employ the operation which is most likely to preserve this function. The only possible attitude of mind at the present time is a judicial one, as exact data are not sufficient to determine the point. I formerly thought that I tore away the ejaculatory ducts in practically every complete suprapubic prostatectomy. Later observations have convinced me that in many cases they are left behind. Even when they are torn off the sexual appetite, erection and orgasm may be preserved though ejaculation is either abolished or occurs into the bladder. Legeve and Papin have collected from the literature exact observations on this subject in cases after suprapubic prostatectomy. They conclude that erection is conserved in the vast majority of cases and that the orgasm is ordinarily preserved. It is my opinion that the

careful avoidance of the ejaculatory ducts by the perineal operation of Young presents little if any sexual advantage over the end results of suprapubic prostatectomy save in the preservation of ejaculation, a point only to be considered in the few cases of procreative age.

The factor of dependent drainage urged in favor of the perineal incision is, I think, of little moment. A large, well-placed suprapubic tube will keep the bladder as dry as the perineal drain, as there is always a puddle in the prostatic bed below the eye of the perineal catheter or drain.

Infection of the suprapubic space is a point against the high operation, as it is more likely to occur than perineal infection. It is my practice to guard against this by closing the lower end of the wound very loosely and passing a wick of gauze or piece of rubber dam down to the loose cellular tissue of the prevesical space.

I yield in my preference for the suprapubic operation (1) in cases of carcinoma when lines of cleavage have been obliterated; (2) in tuberculosis of the prostate; (3) in the small sclerotic prostates of chronic prostatitis or fibrous hypertrophy. All of these groups I rarely operate upon and only upon the strongest indications. When it is necessary to do so the perineal technic as employed by Young is the operation of choice.

In all prostatic work, as well as in major surgical work in general, careful selection of the time for operation is the most important element in success. The functional capabilities of the heart and kidneys must be carefully estimated before operation is attempted. In the estimation of the kidney function I lay most stress upon the twenty-four-hour amount and specific gravity, paying less attention to the chemical and microscopical analyses. Naturally, the presence of sugar, albumin in large amount, or excessive number of casts indicate caution. But inasmuch as the secretory powers of the kidney are the chief factors in the prevention of uræmia, the most common cause of mortality, it is upon the evidence which we may gather concerning renal sufficiency that most stress should be laid.

The various tests for kidney function, urea estimation, cryoscopy, the elimination of phloridzin, indigo-carmin, phenolsulphonephthalein, etc., which have succeeded one another in kaleidoscopic fashion are not in my opinion of as much practical value as their scientific masquerade would appear to imply.

This is my opinion based upon a considerable experience with these tests. It would be very desirable if a method could be devised by which the functional and reserve powers of the kidneys could be estimated, but it is too often the case that these powers do not run parallel with the power of excreting any known substance under ordinary conditions. On the other hand, the daily amount and specific gravity of the urine give us a delicate index of the renal condition.

The condition of the bladder itself is of great importance. Over-distention of the bladder should be relieved before any operation upon the prostate is attempted. Some surgeons have practised prostatectomy at the same time with suprapubic cystostomy for the relief of the vesical retention, and while successes have been reported I regard this procedure as highly dangerous. The nervous and cardiovascular mechanisms in the case of these old men are peculiarly susceptible to derangement and every necessary procedure should be tempered with all possible gentleness and freedom from shock-producing factors. In fact, it is advisable not to relieve an over-distended bladder at once by the catheter, but the residual should be reduced gradually from day to day until the bladder is finally allowed to remain empty.

It is not wise to operate in the presence of acute cystitis, but by an indwelling catheter, or, if necessary, suprapubic cystostomy, acute cystitis may be brought into a quiescent condition. A two stage operation, while not ordinarily advisable, may succeed in the case of enfeebled patients with severely infected urinary tracts. The preliminary cystostomy improves the infection and the general condition to a point when prostatectomy can be done. There is some reason to believe that

chronic cystitis is rather favorable than otherwise, inasmuch as a certain bodily resistance to infection has been generated, the local lymphatics are coffer-dammed and the consequences of post-operative infection are less serious than when operation is done in the presence of an uninfected bladder.

In the preparation of the kidneys the use of water, which is the best diuretic, is paramount. It may be given simply by mouth, or if not tolerated in sufficient quantities in this way, the use of saline by rectum or hypodermatically is sometimes efficient in greatly increasing the excretion of the kidneys. Not until satisfied as to the functional powers of the kidneys, let me repeat, should operation be done.

When the heart, kidneys and bowels are acting properly and the patient evidently in good condition operation may be attempted in the full belief that the immediate outcome will not be affected by the type of operation, provided that it be done with equal skill.

The details of the operation of suprapubic prostatectomy need not be given here. There are several factors upon which, individually, I lay stress.

The bladder is exposed by a clean incision with the knife. There is no scraping away or blunt dissection of the prevesical fat. This minimizes the danger of infection of the prevesical tissues.

The interior of the bladder and the projecting prostate may be directly inspected by the simple process of placing two lateral retractors and one in the fundus of the bladder, the mucosa of which is held by a small piece of gauze. A circular incision is made through the mucosa about the vesical orifice of the urethra. This may be done with the knife scissors or preferably the sharpened finger nail. The purpose of the complete circular incision is to avoid the complication of which I have spoken, namely, the formation of a ragged flap of vesical mucosa which may obstruct the outlet.

While the hemorrhage is rarely annoying it is at times sufficiently free to become dangerous. In the suprapubic operation

it may easily be controlled by placing a suture around the bladder margin of the prostatic bed much in the manner of a purse-string, when a small pack of gauze is placed in this bed and the suture tightened the control of hemorrhage from this source is absolute. Hemorrhage in perineal prostatectomy is not so surely controlled.

After-treatment ranks in importance with the preliminary preparation. I do not use continuous irrigation of the bladder. With a large suprapubic opening the bladder cannot fill with clots and a small amount of clotted blood if it forms makes no difference and readily comes away, while long continued irrigation is in some cases a trial to the patient and accomplishes no good. In the perineal operation I concede its necessity.

Careful nursing is essential. I always employ female nurses, as I feel that they understand better the kindly ministrations which mean so much to the comfort and morale of the patient.

The supply of water and consequent free action of the kidneys are the most important post-operative considerations. Hypodermoclysis is given during recovery from ether, and rectal saline is begun as soon as the patient is quiet. Any sign of diminution of diuresis is met by repeated hypodermoclysis. Spartein and caffeine hypodermatically are often given and seem to give good service. Digitalis and nitroglycerine may be given in cardiovascular weakness. Morphia is shunned, and sedatives in general are given sparingly and only upon the strongest indications.

In three or four days, or as soon as the strength will warrant, he is lifted out of bed into a chair and kept sitting until slight fatigue overtakes him. This should not be overdone, nor should it be omitted as it possesses great stimulating action.

In conclusion, I would summarize the advantages of the suprapubic over the perineal operations as:

1. The approach to the prostate is simple and practically bloodless.

2. The enucleation of adenomatous growths is accomplished with ease.

3. The working field is large and under perfect control.

4. The prostate is accessible and can be made more so by digital pressure on its rectal surface and without the danger of injury to the bladder from the use of tractors necessary in the perineal operation.

5. The muscular control of the bladder is not disturbed, since the internal sphincter may be avoided and the compressor urethræ lies outside the line of cleavage. Incontinence is therefore less frequent following this technic.

6. Permanent fistulæ are less frequent after the suprapubic operation. They never occur in fact if the urethra is bougied.

7. Stones can be more easily removed.

8. Sexual potency is maintained as frequently after the suprapubic operation as after the perineal, and the question of sterility is rarely of any consequence.

9. The mortality is, in properly selected cases, no greater and the percentage of uncomplicated cures is larger.

PROSTATECTOMY IN A GENERAL SURGICAL PRACTICE.

A CLINICAL REPORT.*

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IN this paper is presented the experience of a general surgeon in what has come to be regarded as a special field. It contains a review of most of my work upon the prostate. Probably not more than twelve cases in all are missing and I have reported every one which I could find.

I gratefully acknowledge the kind assistance of my former House Surgeon, Dr. O. Baumann, in preparing most of these histories, and I am indebted to Dr. F. S. Mandlebaum, Pathologist to Mt. Sinai Hospital, for the histological work.

The surgical records at Mt. Sinai Hospital from July 1, 1897, to July 1, 1898, are missing and may have contained six or seven cases. Of late years, in addition to the hospital records, I have been keeping a private file of all the patients upon whom I operate.

There are pretty satisfactory records of eighty patients, a number considerably less than I thought it would be at the beginning of this investigation. In the accompanying review every case has been reported as faithfully as possible without omission and without explaining why certain ones might have been omitted. To me this work has been most instructive and it is hoped that the thoroughly open and frank exposition of my records may help others.

In addition to the general review there are the histories of thirteen patients which I take to be of more than ordinary interest, some of them illustrating special points.

* Read before the New York Surgical Society, January 28, 1914.

General Character of the Cases.—The average age of my patients was something over sixty-four years. The youngest was thirty-six, and the oldest eighty-six. Most of them were badly nourished, feeble old men with hardened arteries and diseased kidneys. A number were the victims of chronic bronchitis. Many, especially among the first operated upon, not being acquainted with the possibilities of prostatic surgery, had waited until the catheter could no longer be passed and urinary sepsis had set in. Fully 90 per cent. of these patients were poor subjects even for minor surgery and perhaps one or two of those who died did not have their days shortened by operation. In fact, one of my patients was considerate enough to succumb from the effects of a cerebral hemorrhage which occurred on the day set for operation, but before the anæsthetic had been administered; another instance which shows that we must not expect too much of statistics.

Two were diabetic. One of these died after a cystotomy; one made an uneventful recovery after a two-stage prostatectomy.

No patient who applied for relief was refused the opportunity which surgery might hold out.

Operative Procedure and Preparation.—I was early convinced through the work of Eugene Fuller that the suprapubic approach was the wisest, all things considered, and I have consistently employed this method, being content to note as a mere observer the results achieved in other ways by my colleagues. I do not doubt that in certain cases perineal prostatectomy may be easier to perform than suprapubic. But my contention is that suprapubic *cystotomy* should be the first step, even though it then appears best to proceed with enucleation from below.

Without going into a discussion of details as to the advantages of the high operation, its simplicity, its freedom from untoward sequelæ, the preservation of sexual potency, the easy sight exploration of the bladder, this alone often changing the entire character of the operation, the absence of danger to the rectum—without, then, discussing these and a

number of other points I may say that according to my observation the choice of methods depends on individual experience. The man who has been trained from the beginning as a genito-urinary specialist will be more apt to choose the perineal route while the one who has become familiar with the broader field of general surgery will probably select the suprapubic. To be sure there are always exceptions.

As an illustration of one of the advantages of the high operation, namely, that of clear and direct vision, I present the following unusual case:

CASE No. 73. *Hypertrophy of Prostate, Carcinoma of Bladder, Two-Stage Prostatectomy, and Extirpation of Carcinoma.*—J. M., eighty-six years old, had suffered for several weeks from repeated and severe hemorrhages from the bladder.

X-ray examination showed no calculus. The condition of the kidneys as well as could be judged with the large admixture of blood was sufficiently good considering the man's years. The amount of urine was ample.

For a number of years there had been frequency of urination but little pain.

The patient entered the Private Pavilion of Mt. Sinai Hospital where an attempt at cystoscopy was made, but the instrument could not be inserted. Catheter showed four ounces of residual urine.

On December 30, 1912, I performed a suprapubic cystotomy in local anæsthesia, exposing an enormous, smooth, lobulated prostate. The patient having reacted well, the second stage was undertaken in general anæsthesia on January 6, 1913, one week after the first. Enucleation was not difficult, but after the prostate had been removed I found a papilloma of considerable size in the right part of the trigonum, the tumor having been invisible until the concealing prostate lobe had been removed. The neoplasm was cut away with its base and was sent together with the prostate for histological examination.

In spite of this man's great age his arteries were in excellent condition and with the exception of some bronchitis he might well have passed as a much younger man.

He was in the hospital for 59 days and was discharged well.

I was told that later he developed epididymitis from which he promptly recovered.

The report of Dr. Mandlebaum on the prostate was, "Marked cystic dilatation of glandular elements; otherwise a simple fibrous hypertrophy. Nothing malignant."

The bladder tumor, however, came back with the diagnosis "papillary carcinoma."

This patient has remained well up to the time of this writing more than a year after his operation. The case well illustrates the common fact that a man may be full of years without being "old."

The operation demonstrated that even a cystoscopic examination would not have disclosed the presence of the malignant growth. Had the perineal operation been performed the complete extirpation of the prostatic enlargement would have left a graver disease behind. I can conceive of no method, except the actual removal of the prostate from above, which would have enabled us to relieve and perhaps cure this man.

As a general rule in these cases I do not perform cystoscopy before operation. The procedure has dangers of its own and I know I shall see the bladder clearly at the time of the operation. If there is little residual urine and I suspect other than prostatic disease, cystoscopy is performed. Were a low operation contemplated, however, the cystoscope even with its additional shock and danger to an old man would be absolutely essential.

One post-operative use for the cystoscope I have found. Before permitting the suprapubic opening to close I fill the bladder from above after having washed it as clean as possible and then insert the cystoscope through the fistula, an absolutely painless and non-shocking procedure. It is easy thus to make a careful inspection for bits of slough or loose tissue which should come away lest they form nuclei for subsequent stone. I have three times observed the formation of calculi following prostatectomy, twice in my own practice and once in that of another surgeon. One of my cases, No. 69, is here reported. The record of the other I was unable to find.

CASE No. 69. *Vesical Calculi Following Prostatectomy.*—E. W., aged sixty-four years, was operated upon for hypertrophy of the prostate and for left hydrocele by the two-stage method, on March 31 and April 2, 1913. The first stage was cystotomy and excision of most of the sac of the hydrocele. The second stage, prostatectomy and left orchidectomy for which I had no permission at the time of the first operation. The testis was in a state of fibrosis and was obviously not functioning.

The patient made a good recovery, although I found it extremely difficult to secure acidity of the urine. He was discharged on May 18, 1913.

During the summer the patient suffered greatly with pain on urination and frequent stoppages of the stream. The urine was very foul.

In October, 1913, he returned to me for examination and with the aid of the sound I found a calculus. Confirmed by cystoscopy.

On October 28, I again opened the bladder suprapubically and removed two rather soft calculi each one the size of a small English walnut. To my surprise these stones had not formed around bits of foreign material. They were pure phosphatic calculi.

I found that the urine could be kept acid by the administration of acid sodium phosphate.

The patient went home about ten days after the lithotomy and has remained perfectly well ever since.

In the two other cases each stone had formed around a bit of tissue.

For the sake of completeness I will describe in a few words the method of procedure carried out in the cases of prostatic hypertrophy, although I would not have it understood that there is any hard and fast rule from which what I might call artistic deviation may not become necessary or advisable.

The Preparation.—First: Catheterization every three to six hours according to the condition of the bladder. The more septic the urine the more frequent the catheterization.

Second: The internal administration of strophanthus or some other cardiac stimulant for the twenty-four hours pre-

ceding operation. Urinary antiseptics with salol or some other chemical which does not liberate formaldehyde.

Third: The patient is not put to bed.

Fourth: Repeated examination of the urine, chemical and microscopic.

I have performed none of the supposed tests for renal function because I do not consider that any of them have been shown to be essential in surgery and because I assume that the kidneys are most probably in a more or less diseased condition and that cystotomy is fully indicated even though we know there is poor renal function. The quantity of the urine, however, is noted.

Fifth: The day before operation the bowels are moved with castor oil.

Sixth: I prefer to perform these operations before noon rather than in the late afternoon so that the immediate post-operative observation shall not be at night.

Seventh: One hour before operation the patient receives a hypodermatic injection of morphine, the dose regulated according to his weight and general condition.

The Operation.—Local anæsthesia. Assistant at the patient's head to talk to him and reassure him and to watch the pulse and other vital phenomena.

Bladder usually emptied by catheter but if catheterization is extremely difficult I have frequently permitted the viscus to fill to its capacity and have operated with urine distention.

Incision through skin and aponeurosis and then separation of muscle fibres to the space of Retzius. If the catheter has been put in, the bladder may now be distended with air by means of a rubber bulb while the operator's finger feels the tenseness and general condition of the bladder wall.

The peritoneum is now pushed up out of the way and held with a blunt retractor, other similar retractors holding the wound apart laterally. Rarely is it necessary to tie or clamp a vessel up to this point.

The patient should be informed that air is to be injected so that he may be prepared for the sensation.

Two traction-sutures are passed through the entire thickness of the bladder wall in its upper presenting part and while these draw the viscus toward the surface the wall is incised by knife-puncture. The opening in the bladder high up facilitates the subsequent closure of the fistula as suggested by Squier. The puncture wound made by the knife is now dilated with dressing forceps and the bladder explored, first by touch, then by sight with the aid of retractors, the patient being placed in a modified Trendelenburg's posture. The holding-sutures on each side of the wound in the bladder are now made fast to the aponeurosis so as to prevent the viscus from falling away from the anterior abdominal wall, exposing too freely the space of Retzius. A large tube is put into the bladder and the external wound is packed with gauze.

The patient is put to bed for the day but as a rule he is made to sit up out of bed the following day if only for a short time. The nurse is instructed to see that frequent deep inspirations are taken. In two or three days he is encouraged to walk, the abdomen being confined by a snug binder. Not until the patient is better than before the operation, both subjectively and objectively, is the second stage undertaken. This period in my list of two-stage cases averaged between eight and nine days.

Second Stage.—Operating table slightly elevated below. Patient prepared for general anæsthesia. Nitrous oxide, nitrous oxide and oxygen, ether, chloroform or one of their combinations or sequences is now given to the point of relaxation.

Digital divulsion of the wound.

No instrument in the urethra.

Bladder thoroughly washed out from above.

The gloved finger of an assistant in the rectum to push up the prostate.

Closed, sharp pointed scissors plunged into the prostatic substance at the internal urethral opening or, if the ungloved hand of the operator is being employed, this opening into the prostate may be made with the fingers.

The prostate enucleated in one or more pieces according to the planes of cleavage.

The prostate is often much smaller and far less vascular eight or nine days after the cystotomy than it was at the first operation and bleeding is therefore minimized.

The prostate having been removed the bladder is flushed with water at about one hundred and ten degrees Fahrenheit, then emptied and drained by tube as after the first operation. If hemorrhage has been profuse I place a packing of gauze upon the mucosa which has now fallen into the hollow from which the gland was removed.

Patient sent back to bed with sand bag upon the abdomen for from twelve to twenty-four hours.

In forty-eight hours the gauze packing is removed and the man is urged to leave the bed and pass part of the day in a chair.

The bladder should be irrigated once a day at least through the tube.

The testicles must be supported.

Whether it is possible to avoid epididymitis by vasectomy I am unable to say. I have practised this method in one of the cases here reported (No. 79, December 30, 1910). Benedetto Cinino (*Zentralblatt für Chirurgie*, 1931, No. 42, page 1644) is quoted as having adopted this method at the time of the primary cystotomy.

I have occasionally noted that after the first week following the prostatectomy an occasional rise of temperature has been explained when rectal examination disclosed retention in the prostatic pocket. This may be emptied by massage once or twice a day and in none of my cases has it caused more than mere annoyance to the operator.

But this is not the place for complete discussion of the subject of convalescence. A detailed work on the management of these cases might well make a volume of considerable size.

A word concerning air inflation of the bladder: Lastaria is quoted in the *Zentralblatt für Chirurgie* (1913, No. 42, page 1645) as favoring cystotomy with the bladder absolutely

empty. There is no objection to this except that it is slightly more difficult, and in local anæsthesia the speed of the operation is of importance. I have repeatedly opened the bladder on a steel sound of large size put in through the urethra and made to present above the pubes after the incision down to the space of Retzius had been made. Lastaria reports a mishap which is supposed to have occurred to another surgeon, Marion, who lost a patient from air embolism after nine hundred cubic centimetres of air had been used to distend the bladder. It was said that at the post-mortem examination the heart was opened under water and that five hundred cubic centimetres of air escaped! It appears remarkable that in the short period of air distention more than half of the air should have entered a vein and reached the heart. It seems also remarkable that the right heart should have been able to hold a pint of air which after death would not escape into the vessels. The report is most unconvincing. I recollect a number of years ago, two German observers reported an experiment in which air had been injected into a dog's bladder. This air was said to have passed up through the ureter, to have reached the kidney pelvis, to have passed in some way through the kidney parenchyma into the renal veins and then to the heart, causing death! I recollect also that not long afterward some other observer failed to verify these observations in a repetition of the experiment.

Certainly, in the conscious human being moderate insufflation of the bladder is usually accompanied by the escape of much of the air alongside the catheter and it is necessary to continue blowing in order to gain sufficient distention for our purpose. Also, it will be noted that no air is pumped in until the finger of the operator is upon the bladder in the space of Retzius. The penis is never ligated to prevent the escape of any excess of air.

A Review of the Tables.—There were forty patients upon whom operations upon the prostate were performed in one stage for non-malignant disease. The age of one of these patients is not given but the others average 64.74 years. Nine

out of the forty died, or 22.5 per cent. The first two cases in this list were not, properly speaking, prostatectomies at all. In one a part of the gland was removed with the *écraseur*, in the other the Paquelin cautery was used. Both died. This would leave 38 prostatectomies proper, with 7 deaths or 18.42 per cent.

The thirty-one patients who were discharged from the hospital spent an average of 35.48 days from the time of the operation to discharge.

There were thirty-three cases exclusive of carcinoma in which prostatic enucleation in two stages was performed. Their ages averaged about the same as the single-stage ones, 64.33 years.

Of these two died or 6.06 per cent. The thirty-one others spent an average of 41.62 days in the hospital—about six weeks. This is 6.14 days more than the average of the single-stage cases. But the average number of days between the first and second stages of the thirty-one discharged patients was 8.7, therefore, two and a half days of this time was, as it were, made up. While this is not a particularly important matter it certainly appears to show that the added operation has no tendency in itself to prolong convalescence.

Among the eighty patients there were seven cases of carcinoma of the prostate or 8.75 per cent. Since, among my earlier patients, only the suspected specimens were examined there might have been cases of carcinoma which were not diagnosed. Of these seven acknowledged cases, however, the average age being about 66 years, two were operated upon by the single-stage method and both died. Five by the two-stage method and four recovered. Two patients showed metastases in the upper part of the femur. The pre-operative histories of these cases of carcinoma were about the same as those of hypertrophy. On examination the stony hardness of the rectal mass would arouse suspicion and at operation the induration of the tumor and the absence of the customary cleavage planes have more than once called my attention to the malignant character of the disease.

All the cases reported here were of the intracapsular non-ulcerating variety. None showed subsequent carcinoma of the suprapubic scar, although I have seen this unfortunate sequel in a case of squamous celled carcinoma of the bladder without prostatic involvement, and it is a well-known phenomenon for papillomata of the bladder to be thus transplanted. It appears to me that the adenocarcinoma which comes as a degenerative focus in a case of adenomatous hypertrophy is not a very malignant form of cancer. Cases 76 and 79 indicate this.

Vesical calculi were found in thirteen cases or 16.25 per cent. It is my observation that in multiple bladder stones or single calculus of great size the postprostatic pouch is apparently deepened by the weight. Simple lithotomy may then be followed by a vesical fistula which will not close without prostatectomy.

In Case No. 44 I performed suprapubic lithotomy, removing twelve large stones which aggregated 120 grammes in weight. The prostate was but slightly enlarged and its elimination was not contemplated. Thirty-two days after the lithotomy, however, although the patient was urinating through the natural passages most of the urine came by way of the fistula. Therefore, I operated again, enucleating the small adenomatous prostate. Recovery was prompt and complete, the patient remaining well until the present time.

Post-operative Complications.—The most frequent condition was epididymitis which occurred seven times. Once the testicle became acutely septic and had to be removed. The other six were what might be called surgical aggravations.

CASE No. 26. *Adenoma of Prostate; no Residual Urine; Suprapubic Prostatectomy.*—S. T., aged forty-seven years, complained of increasing frequency of urination. He had consulted a number of surgeons but because he completely emptied his bladder and because the prostate was very small by rectum operation had not been suggested. There was no bleeding, no loss of weight.

On cystoscopy I found a mass, smooth in outline, just to the left of the median line of the prostate on the posterior wall.

On May 10, 1905, I operated, placing the patient in Trendelenburg's posture and exposing clearly to the eye the little tumor. I removed it easily by enucleation. Nineteen days afterward a left suppurative epididymo-orchitis set in, so severe in character that on June 3, only four days after the onset, I performed orchidectomy. He then made a prompt and permanent recovery. All his symptoms were relieved.

Examination of the tumor showed it to be an adenoma.

The testis was honeycombed with abscesses.

This case is of further interest because the patient was able to empty his bladder completely before operation.

The next complication was that of hemorrhage of which there were five cases.

One a slow continued hemorrhage which was finally checked by cauterization.

CASE No. 52. *Continuous Hemorrhage Following Prostatectomy in Two Stages; Cauterization of Bleeding Point.*—The patient, W. E. S., fifty-eight years old, was operated upon by the two-stage method, the prostatectomy having been performed on November 29, 1907. After the second operation the bleeding never entirely ceased and although Mr. S. was up and about with good appetite he became progressively more anæmic until about two weeks after the operation I was forced to intervene.

In general anæsthesia I dilated the suprapubic wound with the patient in Trendelenburg's posture and easily exposed a minute bleeding vein in the mucosa, there being no hemorrhage from the intravesical prostatic wound itself. The bleeding point was touched with the actual cautery and the patient made a rapid and complete recovery.

Pneumonia occurred three times and one of the patients died.

Three patients had uræmia and all died.

Three patients died after cystotomy without an operation upon the prostate. On careful consideration I have counted these with the one-stage cases. While they were not actually

cases of prostatectomy the complete operation was certainly contemplated, and I think there can be but little doubt that had these patients been subjected to the major procedure at the original operation they would have died just as they did after the minor one.

Among the more unusual forms of prostatic obstruction I report here a case of aberrant prostate. This patient was since my own boyhood my intimate friend and I can corroborate, from personal observation, the interesting facts of the early history.

CASE No. 33. *Aberrant Prostate; Suprapubic Extirpation.*—F. W. L., forty-six years old, had always noted that it took him a very long time to empty his bladder and that the stream was not as forcible as he considered normal. Actual dysuria began about his forty-fourth year when there was occasional retention with the necessity for catheterization. After one of these attacks there was severe cystitis with urinary sepsis.

On March 15, 1907, I performed suprapubic cystotomy. I found an enormous bladder not greatly trabeculated, a large but apparently not diseased prostate, and to the left side and near the floor of the urethra there was a mass the size of a buck-shot, which I removed, cauterizing the base.

Thirty-five days later he left the hospital entirely well and has remained so up to the present time.

Dr. Mandlebaum reported on the histology with the diagnosis of "aberrant prostate." I think there is little doubt that the childhood symptoms of this patient may be ascribed to this peculiar anomaly.

It is to be regretted that pathological examinations were seldom made in my earlier cases.

Besides the review, which speaks for itself, there is little more to say. With the exception of the case of leukæmia here reported (Case 71) and those of carcinoma I am well satisfied with the apparently perfect restoration of function of all the patients who made operative recoveries. My early mortality statistics in the one-stage operation are not brilliant, but again I call attention to the fact that every patient who

came for treatment, no matter how bad the condition, was operated upon. This is not a series of selected cases.

With the two-stage work and its 6 per cent. of mortality I can find little fault. The two patients who died could probably not have been saved by any other method while some whose cases looked most desperate made good recoveries. (For example, case of M. H., No. 60, here reported.)

It is quite probable that increasing skill and experience in the care of these patients both before and after operation may be elements which have a bearing on the improvement of statistics after the adoption of the two-stage operation. Still, the change was of too sudden a nature to be thus accounted for. Also, the loss of a one-stage patient, Case No. 35, after the general adoption of the two-stage principle, and the death of three patients after simple cystotomy form arguments against this theory.

Statistics must be taken for what they are worth. Had I written this paper one year ago there would have been no death rate from the two-stage suprapubic prostatectomy.

CASE No. 8. *Post-operative Hypogastric Hernia*.—J. R. This patient, sixty-one years old, was admitted to Mt. Sinai Hospital on May 16, 1901, with a suprapubic sinus of small size from a previous cystostomy. This was in the early days of radical prostatic surgery and at the time of his first operation the surgeon who operated was not prepared to perform prostatectomy.

The patient had much pus and blood in his urine and there was a massive suprapubic cicatrix with a pelvic exudate pericystic in character.

On May 25, in nitrous oxide and ether anæsthesia I excised the sinus and removed a large fibromatous prostatic mass. The wound was healed and the patient discharged on August 17, fifty-one days after the operation. The pelvic exudate had not yet, however, absorbed.

I followed this case for a number of years and it is the only one in which I ever saw a suprapubic hernia develop. This hernia had no neck but was a general bulging of the entire hypogastric abdominal wall. It was easily retained by a binder.

CASE No. 15. *Spinal Syphilis; Previous Bottini's Operation;*

Single-Stage Suprapubic Prostatectomy.—Nathan M., aged sixty-four years, was admitted to Mt. Sinai Hospital on July 14, 1902. He was suffering from advanced spinal syphilis of the tabetic type. For some years he had had bladder symptoms with retention and overflow, the so-called residual urine amounting to about 16 ounces. More than a year before his admission to Mt. Sinai he had been operated upon by the Bottini cauterization method but without relief and an authoritative neurological opinion was that the vesical retention was caused by his spinal lesion.

Cystoscopic diagnosis was not so accurate in those days as it is now, but by the more usual general examination I concluded that a suprapubic exploration was justified.

Accordingly, on July 15, 1902, I opened the bladder under gas and ether anæsthesia followed by chloroform. It was at once evident that a considerable hypertrophy of the prostate existed and that a pedunculate middle lobe had been divided sagittally by the Bottini's cautery. The two parts had not fused in healing but fell together in such a manner that they effectually blocked the urethra. Prostatectomy in the usual manner was performed and 34 days later the patient left the hospital well.

He remained in perfect health so far as his urinary apparatus was concerned and died only a year ago.

CASE No. 35. *Prostatic Hypertrophy With Retention and Overflow; Myocarditis; One-Stage Suprapubic Prostatectomy; Death.*—N. N., aged seventy-one years, after two years of bladder symptoms had an attack of retention and overflow which continued for about a week before a catheter was passed.

I strongly advised cystotomy then prostatectomy but the patient and his friends were most urgent in their desire for a one-stage operation and most unfortunately I acceded.

On April 22, 1907, I operated opening the bladder suprapubically under local anæsthesia then continuing with ether. There was little bleeding and no cause for shock but the patient went to pieces and died a cardiac death in about twenty-four hours.

Post-mortem examination showed grave disease of the coronary arteries. The prostate was the seat of adenomatous hypertrophy.

CASE No. 39. *Vesical Calculi; Enlarged Prostate; Deaf Mutism; One Stage Prostatectomy.*—J. S., aged forty-two years, was admitted to Mt. Sinai Hospital on April 2, 1912. The patient

was a deaf mute and was unable to read or write and indicated by signs that he had pain in the urethra on urination.

The X-ray showed vesical calculi. The general health of the man was good and on April 8, 1912, I performed a suprapubic cystotomy in general anæsthesia. Four calculi were removed and on exposing the bladder the mucosa was found tensely injected. There was a deep retroprostatic pouch and the prostate itself, though distinctly enlarged and of such form as to cause a barrier to urination, was probably not the sole cause of the distressing symptoms. Enucleation in three pieces. The bladder was much hypertrophied and of a rather abnormal shape, being considerably elongated but not widened. It had evidently been in a state of chronic spasm so that it held practically no fluid when the patient was not anæsthetized.

The reason for breaking my rule and performing this prostatectomy at one sitting was because of the difficulty in making the patient understand. His condition also was so good that the added risk did not appear to be great.

The histology of the specimen which was removed was "adenoma, hypertrophy of the ducts, perifollicular inflammation."

A number of days after the suprapubic wound had healed it broke down again following an attack of retention probably due to the presence of a loose slough which interfered with urination. The wound closed and thirty-four days after operation the patient was discharged from the hospital urinating normally.

CASE No. 36. *Adenomatous Hypertrophy of the Prostate With Acute Inflammation; Prostatectomy.*—J. L., thirty-six years of age, was operated upon on December 25, 1907. There had been repeated attacks of urethritis and distinct prostatism.

The past history of the patient was one of sexual excess. For more than a year there had been dysuria with incomplete emptying of the bladder. By rectum there was a large, soft, rather tender prostate.

At the operation characteristic hypertrophy of the prostate was found and the mass enucleated. It was 30 grammes in weight and honeycombed with purulent foci.

Histology reported by Dr. Mandlebaum as "adenomatous hypertrophy with acute inflammation."

In four weeks he was well and he has remained well. Virility and urination normal.

CASE No. 40. *Suprapubic Cystotomy; Death.*—This case is one of a man seventy-three years of age, M. R., who was admitted to Mt. Sinai Hospital on January 12, 1913. He had retention with overflow. The urine contained a large amount of albumin, red blood cells and many white cells.

On January 13, 1913, under local anæsthesia I opened his bladder for drainage, intending to perform prostatectomy at another time. His condition after the operation was good, but in twenty-four hours he became noisy, delirious and uræmic, with fatal issue.

CASE No. 60. *Enormous Vesical Calculus; Hypertrophy of Prostate; Myocarditis; Glaucoma; Two-State Prostatectomy.*—This patient, M. H., had had 15 years of dysuria. He had been examined by many physicians and surgeons. When I saw him in October, 1910, there was constant vesical tenesmus and after urination only a few drops of what was thought to be "residual" was obtained by catheter. I immediately advised radiography which the man put off for two months longer. He then entered Mt. Sinai Hospital in a dreadful condition with urinary sepsis, a miserably acting heart and almost blind on account of his glaucoma.

Radiography showed a shadow of great size far above the pubic region. Cystoscopy caused severe hemorrhage so I had to desist, but the searcher immediately felt the stone. I at once opened the bladder and removed a calculus which when perfectly dry weighed 3 ounces. The bladder wall hugged the calculus closely, the high position of the stone being explained when I discovered a prostate so large that the stone, as it were, on top of it was far above the pubes.

A week after the lithotomy, in chloroform anæsthesia by Doctor Bennett, I enucleated a prostate the size of a large lemon. Recovery was perfect with the customary great improvement in general health.

This man I considered to have been what I might call the worst surgical risk of my entire experience.

CASE No. 71. *Suprapubic Prostatectomy in a Leukæmic Patient.*—The following history is of interest principally because of the unusual complication of leukæmia. In this fatal disease

one would naturally make every effort to avoid a capital surgical operation on account of the well-known hemorrhagic tendency.

In this case, however, the vesical condition had become so threatening that something had to be done. Fortunately there was an operative recovery.

G. S., aged seventy-two, had suffered for some years with the usual symptoms of prostatic obstruction and had been catheterizing himself with a woven instrument for one year.

In August, 1913, he had been operated upon for a left strangulated inguinal hernia and for the three following weeks he had evidently suffered from vesical distention with overflow, no catheter having been passed during that time.

At his own suggestion his physician catheterized him and withdrew then a large quantity of urine containing much foul pus.

On September 20, 1913, he came to New York where he entered Miss Maluk's private hospital.

I found a feeble, pale, emaciated man. The temperature, however, was normal and the pulse 80, showing some hypertension. Twenty-three ounces of extremely foul urine were withdrawn by catheter the last part of which was almost pure pus. Frequent catheterization and irrigation improved him and on September 24, 1913, I performed suprapubic cystotomy preliminary to a contemplated prostatectomy. At this time there were fifteen ounces of residual urine. By rectum there was a large soft prostate. The spleen was very large and hard, extending beyond the median line and far below the umbilicus. The patient stated that he had had malaria and that a physician had told him twelve years before that he had an enlarged spleen. The lymph-nodes in the various parts of the body were not enlarged and at this time no blood examination was made.

A week later, in gas and ether anæsthesia, a prostate three ounces in weight was enucleated. The lobe on the anterior wall was very large and fleshy.

Thirty-seven days after the first operation he was discharged urinating normally and apparently in excellent general condition. Within the next few weeks he gained 16 pounds in weight and I dismissed the case from my mind. Then, however, he began to have pain in the region of the old hernia wound and an induration with slight reddening of the skin appeared there. Although the temperature remained normal I thought that probably a deep,

mild infection existed. Gradually the left leg and thigh became flexed so that walking was impossible on account of the pain in the groin. No spontaneous pain. Appetite good. Pulse good. The spleen appeared to be somewhat larger than it was while at the hospital, now filling the entire left upper quadrant.

Thinking that a viscus had become adherent at the site of the old hernia operation I sent the patient to Mt. Sinai Hospital where on November 28, 1913, in ether anæsthesia, a small incision was made through the lower part of the left rectus muscle and the finger then detected a large mass of apparently retroperitoneal lymph-glands. No hernia or adhesion was present. The blood, meantime, had been examined and showed the characteristic picture of a lymphatic leukæmia.

Although this patient had been able to empty his bladder perfectly the urine became foul during the three days following the operation and the suprapubic wound reopened. It closed again within 36 hours and a week after the operation he was discharged.

CASE No. 72. *Prostatic Hypertrophy; Operation in Two Stages; Death.*—J. G. P., aged seventy-five years, was operated upon on October 28, 1913, the bladder being opened under local anæsthesia.

For several years there had been symptoms of prostatic disease with cystitis, and catheterization had been necessary. The patient had albumin and casts, indicating a type of nephritis which might be expected in a man of his years. The kidneys were, however, functioning in a comparatively normal manner.

After the cystotomy, although there was plenty of urine, the patient developed hiccough and this continued without intermission for fourteen days. At the end of two more weeks, however, or 27 days following the first operation, his condition was better than it had been before the first stage and under nitrous oxide gas and oxygen the prostate was easily enucleated. The patient had a chronic bronchitis and after the second stage there was considerable cough and again for three or four days, hiccough. Everything then, however, appeared to be going on very smoothly and we hoped for a speedy recovery when, without warning, the heart gave out and eight days after his second operation there was general œdema terminating in pulmonary œdema and death.

In this case, in order to be on the safe side, I waited 27 days

between the two operations. During this time the patient was repeatedly examined and had gained so much in strength that he was walking about like a well man. The result was naturally most disappointing.

It appears to me that hiccough is in these cases a symptom pointing to renal or cardiorenal insufficiency.

NOTE.—After the meeting one of my colleagues privately expressed the opinion that the three fatal cystotomies should have been counted among the two-stage cases of prostatectomy. On arguing the matter with a number of others, I have come to the conclusion that these three cases should in truth not be counted at all, since they were not operations upon the prostate. In the anteprostatectomy days suprapubic cystotomy was common as a relief measure—and this operation had a very considerable mortality.

For the sake of completing the statistics then there may be counted 37 cases of one-stage operations upon the prostate—not 40—with 16.21 per cent. mortality. The mere matter of intention cannot change the fact that no prostatic operation was done.

TABLE OF MORTALITY.

Case No.	Cause of Death.	One-stage.	Two-stage.	Number of Days after last Operation.
2	Uræmia ("gradual deterioration")...	1	....	10
10	Uræmia	1	....	6
40	Uræmia	1	....	5
1	Shock (hemorrhage).....	1	....	1
74	Shock (hemorrhage), carcinoma.....	1	....	5
7	Shock	1	....	1
75	Shock (carcinoma).....	1	....	1
28	"Collapse," no hemorrhage.....	1	....	2
30	Cardiorenal.....	1	....	3
72	Cardiorenal.....	....	1	8
35	Cardiac.....	1	....	1
16	Coma (diabetic).....	1	....	4
70	Pneumonia .....	....	1	3
78	Gradual deterioration (carcinoma)...	....	1	50

Nogy.	Result.	Remarks.
.....	Died	Crude technic.
.....	Died	
.....	Well	Patient well in about four weeks; lived four years with perfect function.
ertrophy	Well	Followed up for years.
ertrophy	Well	Followed up for years.
(prostate	Well	Followed many years.
ogical ex-)		
.....	Died	Autopsy showed right pus kidney; very large prostate found at operation but not removed.
.....	Well	Hernia in suprapubic region but easily held by pad and bandage; followed for years well.
.....	Well	Well for some years.
rostate	Died	Drained over 100 ounces a day but died in coma; no glycosuria.
I.....	Well	
I.....	Well	Died some months later; suppuration of perineal wound contributory cause.
I.....	Well	Well ten years later.
I.....	Well	
I.....	Well	Had been operated upon by Bottini's cauterization method without relief; case was said to be one of "spinal" retention; perfect function after prostatectomy.
I.....	Died	
I.....	Well	Remained well several years, dying of cardiorenal insufficiency.
I.....	Well	
I.....	Well	
2 glandular	Well	Well for years; unusual increase in sexual power.
hy		
2.....	Well	Several months of impotency, then recovery.
2.....	Well	Ten years before he had had suprapubic cystotomy by another surgeon; some of the prostate said to have been burned away at that time; healing after my operation very slow because of former transverse cut; my own line was sagittal.
2.....	Well	
2.....	Well	
2.....	Well	Followed years well.
2 chronic	Well	19 days after operation left epididymo-orchitis with suppuration; 4 days later the left testis was removed; rapid recovery.
ion		
2.....	Well	
2a	Died	Collapse twenty-four hours after operation; no remarkable hemorrhage.
2.....	Well	Followed for years well.
3 mation	Died	Note advanced age of patient; probably cardiorenal death.
3.....	Well	
3 atous	Well	Is well now (1914).
ny		
3 prostate	Well	Is well now (1914); history in body of paper.
c degen-		
3.....	Well	Patient has remained well (1914).
3s hyper-	Died	Postmortem showed atheroma of coronary arteries. I was persuaded against better judgment to perform this operation in one stage.
3s hyper-	Well	Prostate honeycombed with purulent foci; about 30 grammes in weight.
th acute		
ion		
3 hypertro-	Well	
3s and	Well	Followed to date well.
prolifer-		
3 hypertro-	Well	Case in body of paper.
ts; peri-		
nflam-		
4.....	Died	Case in body of paper.



A METHOD OF EXPOSING THE LOWER END OF THE URETER.

BY EDWIN STARR JUDD, M.D.,
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(From the Mayo Clinic.)

THE method herein described of approaching the lower part of the ureter has been employed in operating on six cases in our clinic. So far as I have been able to learn, the method has not been previously reported, and because of the many difficulties encountered in removing a small stone caught in the part of the ureter which runs through the wall of the bladder, a short description of this procedure seems not out of place.

The first patient operated on was a boy eighteen years of age with diverticulum of the bladder. The diverticulum was about three inches long and one inch in diameter and communicated with the bladder by an opening about one-half inch in diameter in front of the meatus of the left ureter. At the cystoscopic examination, a spurt of urine could be seen at the edge of the opening into the diverticulum, but a catheter was introduced into the ureter with great difficulty, evidently because of the deformity produced in the ureter by the diverticulum. The symptoms in this case were very suggestive of diverticulum and the diagnosis was confirmed by the cystoscope.

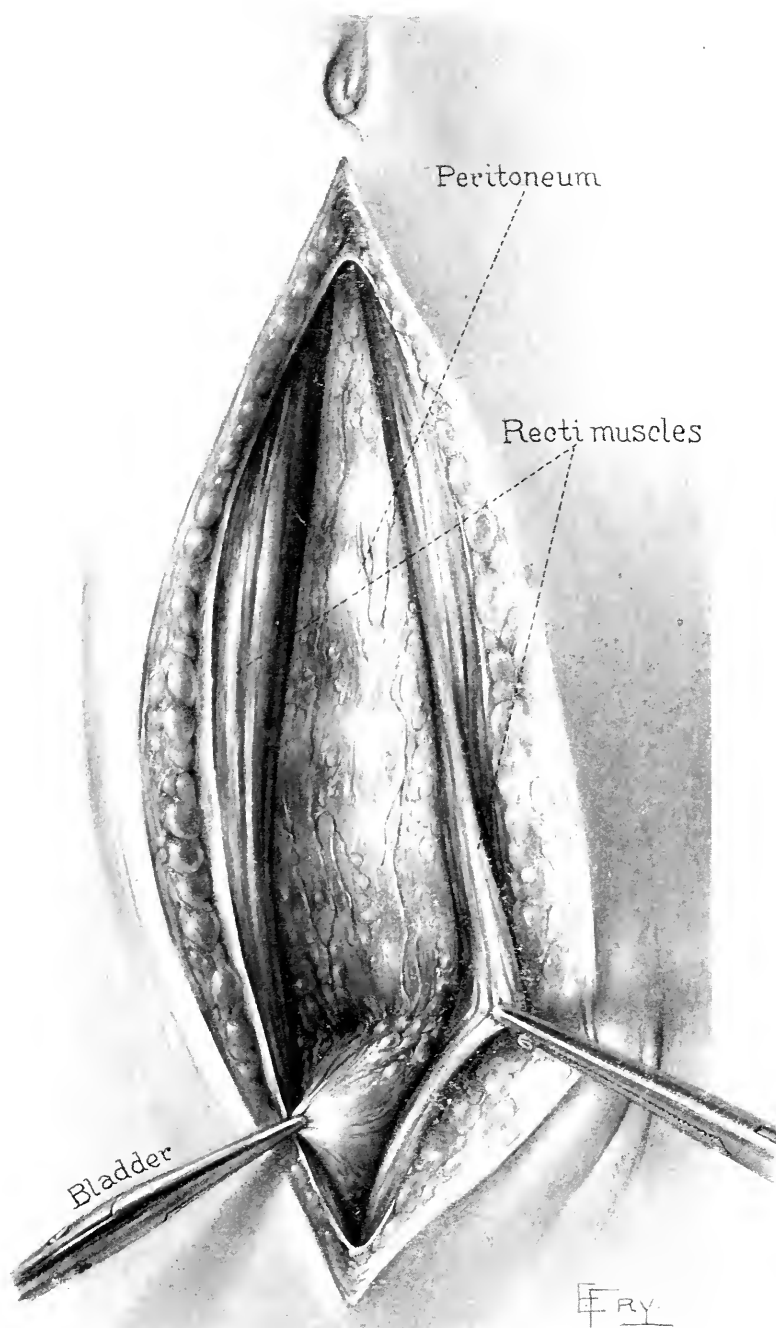
Operation.—The patient was placed in a moderate Trendelenberg posture and a median suprapubic incision made from the symphysis to the umbilicus, extending through the fascia between the recti muscles down to the peritoneum. The peritoneum was not opened but was brushed back from the fundus of the bladder in the usual way, the bladder lifted well forward and opened after the suprapubic space had been packed off with gauze. The bladder was opened in order to explore and pack the diverticulum to facilitate in removing and also to determine if possible the rela-

tionship of the diverticulum and ureter so that the ureter would not be injured in removing the pouch. This, however, could not be satisfactorily accomplished from within the bladder and with the wall of the left side of the bladder held firmly by an assistant, dissection was carried down to the base of the bladder, exposing and freeing the ureter for 2 or 3 inches. The ureter was held to one side while the diverticulum was separated from the surrounding fatty tissue and removed. The opening in the bladder was closed with the ureter in sight so that it could not be injured or its lumen interfered with. Two small rubber tissue drains were left down in the space at the side of the bladder where the diverticulum had been. These drains were removed on the third and fourth days. There had been no drainage of urine; just a little serum. The entire wound healed practically by primary intention and the patient was up and around in ten days and made a complete recovery. A letter from him two months after the operation states that he is well.

In the second and third cases, the operation was performed for stones in the lower ureter. In the second case a small stone was firmly lodged in the lower end of the right ureter. The Röntgenogram and the cystoscopic examinations confirmed the diagnosis. The patient, a female, aged thirty-one years, had been having repeated typical attacks of colic.

Operation.—The ureter was exposed as in the preceding case with the diverticulum, except that the bladder was not opened. As soon as the peritoneum had been reflected from the bladder for a little distance the right side of the bladder was retracted toward the midline and held firmly. After a very little dissection through the fat toward the base of the bladder, the stone could readily be felt. Before manipulating the stone the ureter was freed for an inch and a half or two inches above the bladder and a pair of tacking forceps were clasped across the ureter. This was done to prevent the stone from slipping up the ureter in case it became dislodged. The stone was then grasped between the fingers and removed through a small longitudinal incision in the ureter. No attempt was made to suture the opening. A rubber tissue drain was inserted and removed on the fifth day. There was

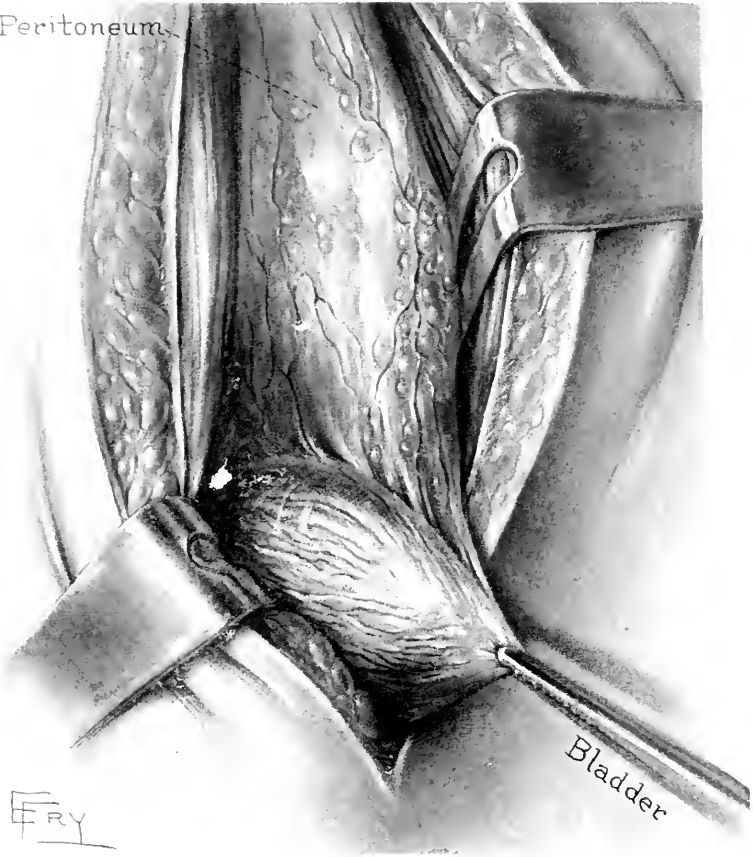
FIG. 1.



Showing regular suprapubic incision, with bladder lifted up. Peritoneum and fat have not been dissected from top of bladder.

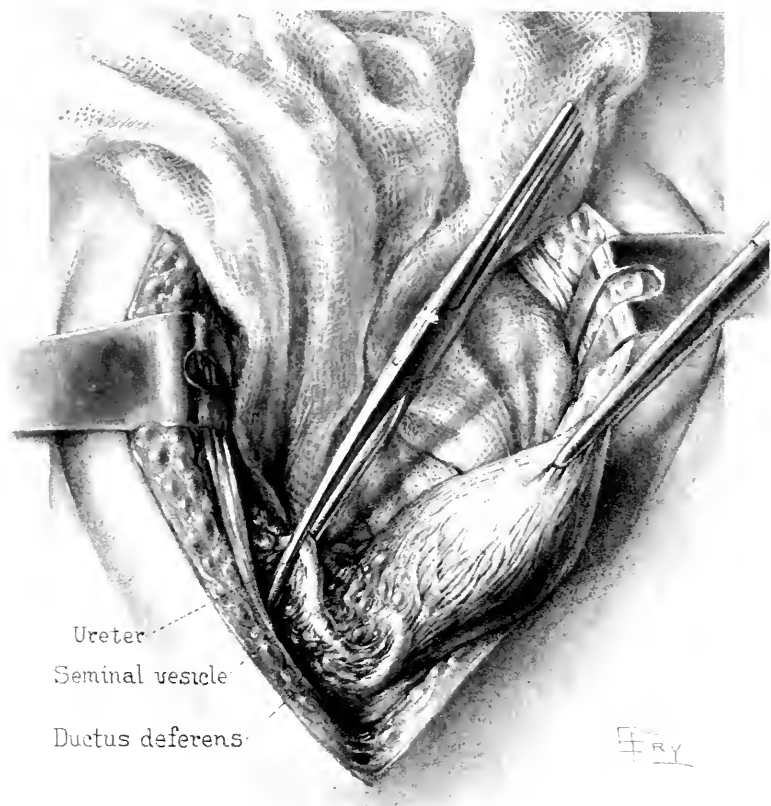
FIG. 2.

Peritoneum



Shows same incision with the peritoneum and fat dissected off. The bladder is held to one side by soft forceps which do not grasp the muscular wall of bladder.

FIG. 3.



Bladder held well to the side. Dissection through the fat shows seminal vesicle running above the ureter. Ureter dissected free for an inch or more and grasped by tacking forceps, which do not compress wall of ureter but close it together to prevent stone slipping back if it becomes dislodged.

little, if any, leakage of urine and the patient made a satisfactory convalescence.

In the third case, in addition to the attacks of colic due to the stone in the ureter, which was shown also by both Röntgen and cystoscopic examinations, there was also conclusive evidence of previous and recent attacks of appendicitis. In this case the patient was a male, aged twenty-seven years.

Operation.—As in the previous cases, the incision was made in the midline between the recti muscles. In this instance, however, it was continued through the peritoneum, and the appendix, which was subacutely inflamed, was removed. The stone in the right ureter about 4 inches from the bladder could readily be located by exploring from within the peritoneal cavity. After the appendix was removed, the opening in the peritoneum was closed and protected by gauze pads. The ureter was exposed as in the previous cases and a stone about a half inch long and a third of an inch in diameter was removed. The usual rubber tissue drains were left in the wound for several days. In this case there was drainage of some urine through the wound at first but the wound was entirely closed within ten days.

Besides these two cases of stone in the ureter and the one of diverticulum of the bladder, the method has been used to expose the ureter in three cases of extraperitoneal resection of the bladder for cancer. In these three cases the resections were for the removal of a considerable portion of the bladder which contains one of the ureteral openings, and it was necessary to expose the ureters at this point outside of the bladder in order to transplant them satisfactorily.

With our limited experience, thus far this technic seems to have some advantage over the other methods, especially for the removal of stone. The search for the ureter may be quite tedious, though if it contains a stone, as in our two cases, it can be located by using the stone as a guide. In the female the uterine artery will usually be exposed; in the male, the seminal vesicle may at first be taken for the ureter, though the difference will soon be discovered.

RECTOVESICAL ECHINOCOCCUS CYST.*

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THE usual sites of implantation and growth of echinococcus disease have long been noted and the surgical indications satisfactorily worked out. It is only when the disease presents bizarre features that it assumes importance of sufficient interest to warrant a record of the case. On such grounds the case about to be detailed seems qualified for publication.

An Italian, thirty-five years of age, was brought to me by his physician, on September 21, 1913, with the diagnosis of an enormous vesical calculus. The diagnosis had been arrived at after radiograph examination. The patient was greatly emaciated and his chief complaint was frequent urination and intense pain in the glans penis. The abdomen was distended by a tumor occupying the hypogastrium, whose upper limit was midway between the ensiform and navel. Percussion and palpation of the tumor indicated it to be a greatly distended bladder. Rectal examination showed a marked bulging of the tumor in this situation, compressing the rectum. Bimanually the tumor felt cystic, a soft rubber catheter passed to the bladder without obstruction, and six ounces of clear urine was obtained.

Cystoscopic examination was impossible, the reason of which will be shortly appreciated. The previous history of the patient did not add much. He had been losing weight and strength for months, the abdomen had been steadily increasing in size and the above mentioned vesical symptoms in severity.

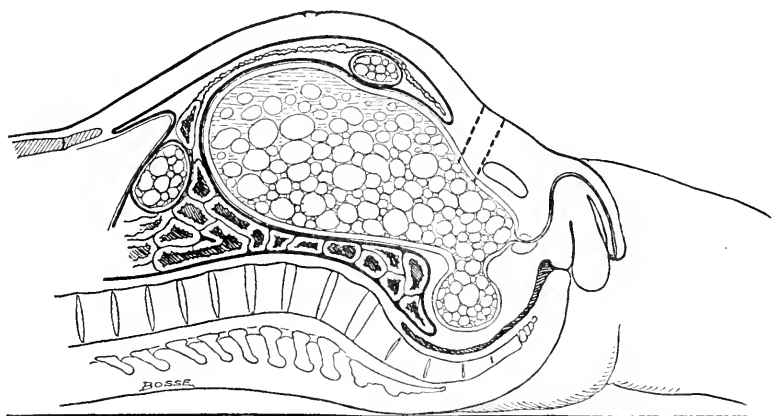
The radiograph submitted by his physician showed at a glance that a faulty interpretation of the findings had been made.

The shadow mistaken for a calculus being outside the bladder area, cystotomy was decided upon and accomplished under a

* Presented before the New York Academy of Medicine, Genito-Urinary Section, November 19, 1913.

whiff of nitrous oxide anæsthesia, the patient's condition not admitting of any prolonged anæsthesia or exploratory operation (see Fig. 1).

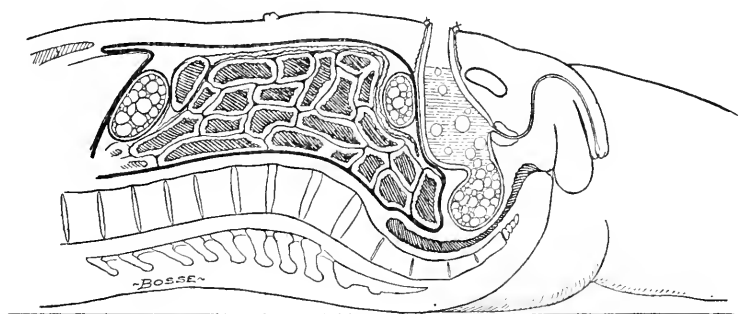
FIG. 1.



Original condition. Rectovesical cyst, cyst distended bladder, cyst on liver surface and cyst of omentum.

As soon as the bladder was incised multitudes of echinococcal daughter cysts forced themselves out of the bladder. The incision was enlarged and between two and three hundred of these cysts were evacuated from within the bladder.

FIG. 2.



Condition after first operation. Bladder sutured to skin for drainage.

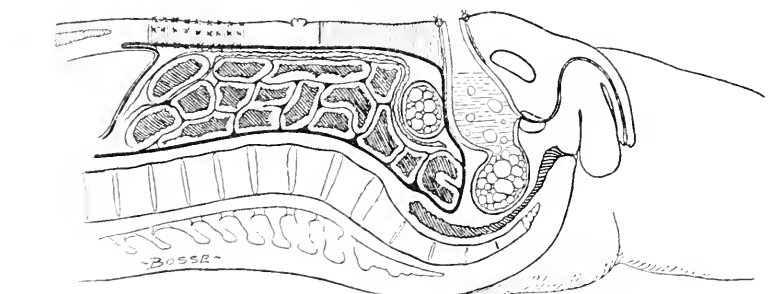
The patient's condition being precarious it was decided to omit an extensive search for the mother cyst, contenting one's self with suturing the bladder to the skin and providing for constant drainage (Fig. 2). The patient, following operation, im-

proved from the start. The evacuation of the cyst-filled bladder caused disappearance of the main tumor, and made possible further examination of the abdomen by palpation. Such examination revealed a tumor mass, situated in the region of the right epigastrium.

As speculation had been rife as to the manner the echinococcal disease had invaded the man's bladder, the finding of this mass offered a possible explanation; namely, that the disease was primary in the kidney and the bladder had been involved by cysts passing down the ureter. More careful examination of this right-sided mass, however, made one suspicious that it might as well be connected with the liver as the kidney.

Ten days after the cystotomy the right kidney was explored

FIG. 3.



Condition after second operation. Liver cyst removed.

and found to be normal, the mass being situated within the peritoneal cavity. An anterior incision was then made through the right semilunaris over the region of the hepatic notch. The tumor was found adhered to the edge and under surface of the liver. It was carefully dissected away without opening its capsule and was about the size of a large orange. It proved to be an echinococcus cyst. The patient recovered from operation without incident but the cause of the bladder condition remained, as yet, unsolved. One week following this, a third operation was undertaken to close the urinary bladder and for further investigation. At this time it was still possible to fish daughter cysts out of the bladder through the suprapubic opening (Fig. 3).

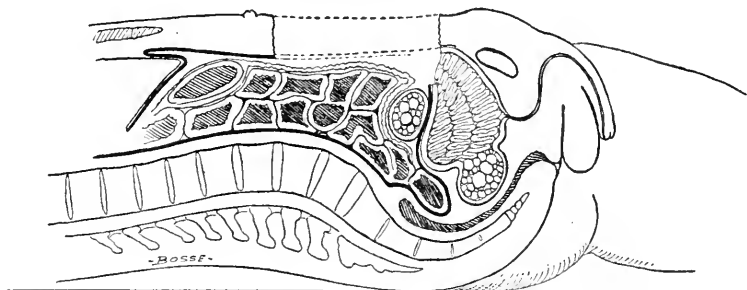
Preparatory to this final operation the bladder was tightly packed with iodoform gauze and the patient placed in the

Trendelenburg position. The peritoneal cavity was opened by a median abdominal incision running upward from the suprapubic incision (Fig. 4).

The omentum was adherent to the peritoneum covering the fundus of the bladder and a small echinococcus cyst was discovered at the point of adherence on the right side. This cyst was excised without rupture.

The attachment of the bladder to the skin (result of first operation) was loosened and the peritoneum stripped off the fundus of bladder. The existing incision in the bladder was carried around behind and a perfect view of its interior obtained. The bladder was found free of cysts or of cyst wall detritus, but an opening was discovered in the trigone about the size of a half dollar. This opening communicated with a large mother cyst,

FIG. 4.



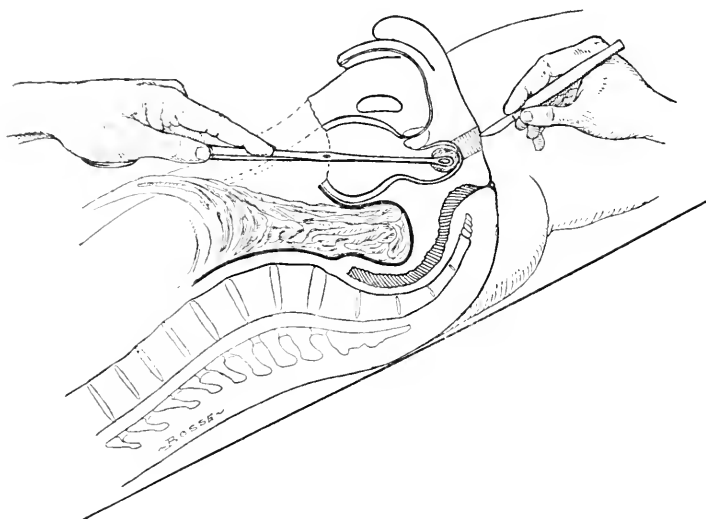
Third operation, first step. Removal of cyst of omentum (bladder packed with gauze

situated between the rectum and bladder below the peritoneal reflection. The mystery was at once cleared up: The daughter cysts were being manufactured in the mother cyst and the urinary bladder had been used as a storehouse for them until nature had objected to the overcrowding. From this point on, the surgical management of the case was as follows: A sponge holder, carrying a small gauze wipe, was introduced into the mother cyst through the opening in the floor of the bladder and then pushed down towards the perineum. A perineal dissection was then made between rectum and prostate and the cyst capsule pulled down, incised, and sutured, to the skin of the perineum (Fig. 5).

Through this perineal opening the mother cyst was curetted and pure carbolic acid applied to its wall.

The communication between cyst and trigone was closed, after freshening the edges, by catgut sutures, leaving a small opening

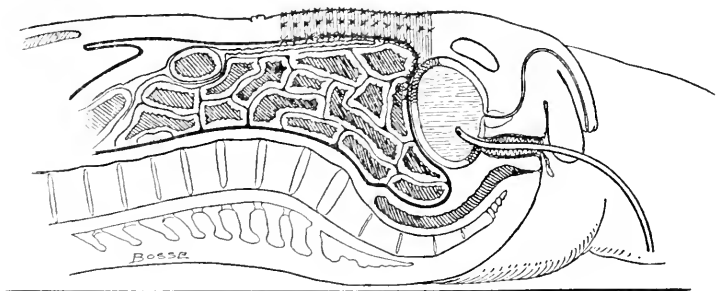
FIG. 5.



Third operation, second step. Mother cyst incised through the perineum.

at the lower angle of the wound through which the bladder was drained. Drainage was carried out by inserting a 26 French

FIG. 6.



Third operation, final step. Cyst wall sutured to skin of perineum. Opening between bladder and cyst closed up to catheter inserted for drainage. Wound in fundus of bladder closed without drainage. Peritoneum and abdominal wound closed.

catheter from the perineal wound, through the cyst cavity into the bladder. The suprapubic bladder wound was completely

closed. The peritoneum was sutured closing peritoneal from perivesical space, and the abdominal incision closed without drainage (Fig. 6).

The operation was tedious but the patient recovered without reaction. The perineal tube was removed at the end of four days and the bladder wound healed quickly. The cyst cavity was irrigated with iodine solution and rapidly contracted.

The abdominal incision healed by first intention.

The patient has steadily gained in strength and is relieved from his malady.

FRACTURE OF THE PENIS.

BY ABRAHAM O. WILENSKY, M.D.,

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INJURIES of the penis, occurring as the result of the ordinary accidents, incident to the carrying on of our daily life, are fairly common. These include contusions and hæmatomata, and tears and lacerations of the body of the organ, usually communicating with the exterior, either through the outside skin, or very frequently through the urethra, the tear in the latter cases extending from within the canal outward. These injuries may be the result of a fall astride a fence or other sufficiently large object, or the result of a kick or blow, directed at the genitalia. Whenever a tear extends through the urethra, the urethral lesion should be regarded as the principal one.

Subcutaneous rupture of the penile body, or fracture of the penis, occurring during intercourse, is a most unusual accident, and of such an unfortunate happening, we have recently had an example at our clinic in the Mount Sinai Hospital Dispensary.

CASE No. 950, series of 1912.—A very thoroughly frightened Italian, thirty-six years old, appeared at the clinic, with the story that early that morning, during intercourse with his wife, he had experienced a sudden severe pain in his penis, that he had withdrawn it immediately thereafter, and that it had then swollen very quickly, and had assumed the shape and appearance shown in the accompanying drawing (which is about one-half the actual size of the damaged organ). The patient was able to void voluntarily, the resulting urine being free from blood. Three months previously, he had had an attack of gonorrhœa, and had been treated only indifferently well; there had been no complications.

FIG. 1.



Ecchymotic infiltration swelling of penis after subcutaneous rupture (fracture of the penis).



He had been told, that for his present trouble an amputation of the penis would be necessary.

A word in regard to the anatomy of the penis may not be amiss. It is made up of three bodies, which histologically are composed of erectile tissue. The two dorsal bodies, or corpora cavernosa, are side by side, separated by a very dense and firm fibrous septum, and together they furnish the groove, on the ventral side of the organ, which receives the third body, or corpus spongiosum. Each body has a similar structure, that is, a mass of erectile tissue, contained in a strong envelope, made up of connective tissue fibres, smooth muscle cells, and elastic fibres. The tunica albuginea of the dorsal bodies is very thick and strong, that of the spongy body is thin and weak, and shows a predominance of elastic tissue and smooth muscle cells. The reason for this is apparent when we remember that the corpus spongiosum lodges the canal of the urethra, there being a distinct strata of smooth muscle cells directly surrounding the canal. The relative thinness of structure of the sheath of the spongy body furnishes a point of election for the reception of injuries; its proximity to the canal of the urethra, inflammatory changes, which predispose to their occurrence.

The term "fracture" as applied to this condition is a misnomer, inasmuch as it implies a lesion of bone. In the human subject, there is no os penis, a condition which is regularly found in some of the lower animals. In these animals, curiously enough, fracture of the penis never occurs. In the human subject, we occasionally come across patients, who have collections of bony tissue of larger or smaller degree, usually gathered either in the septum, or in the tunica on its dorsal aspect. These are not true penile bones, but pathological conditions, the result almost always of syphilis, in combination with a local continuous irritative trauma, as from the wearing of a corset.

In the *Fortschritte auf dem Gebiete der Roentgenstrahlen*, for 1903, Brohl cites a case of a young man of twenty years, with an os penis. The X-ray photograph shows the shadow of a central column with two lateral

branches, composed of bony tissue. A true os penis is a thin pencil shaped bone, pointed at its free extremity, and broader at the root of the organ. The case cited is evidently one of syphilitic calcification of the fibrous septum.

One finds very little regarding this condition in the literature of medicine. It is first mentioned in 1849, in the *American Journal of the Medical Sciences*, the article being referred to in *La Gazette des Hopitaux*, of the same year. Prior to 1887, there are but five references to this lesion, and since then the references are few and far between.

There is no point of election for the position of the fracture. It may be at the centre or at either end of the penis. The tear always takes place when the organ is in the erect condition. Owing to the fact that the tunica of the spongy body is weaker and thinner than that of the corpora cavernosa, the tear almost always begins in the former, and may or may not extend into the latter. It is never very deep, for the reason, that as soon as the tunica begins to tear, the erectability of the penis is immediately disturbed, the organ becomes flaccid, and the tearing process, of necessity, stops. The tear as a rule does not extend through into the lumen of the urethra; and whenever we find free bleeding from the meatus, the lesion is a laceration of the urethra, with the tear extending for a short distance into the substance of the spongy body. One should not confuse these two conditions, as one is very apt to do, in looking through the literature.

Free bleeding always occurs under the skin, and a large hæmatoma forms; in addition the penis enlarges enormously from an associated œdema. At the line of fracture, a bending of the organ takes place; this may be very acute, as in the case reported herewith. It occurs mechanically, owing to the fact that the penis becomes longer on the torn side. Of course the concavity of the deflection is toward the untorn side.

When the process is not disturbed, the hæmatoma is slowly absorbed, and is replaced by a hard scar. Deformity, of more or less extent, usually persists; and the power of erection is

lost in all but the least severe cases. Sometimes, even in the bad cases, the penis may regain this power, but it then does so in two stages: the part posterior to the lesion becomes erect, and following that, the part anterior is distended with blood.

One frequently sees men, in the organs of whom one can feel small shot-like bodies, attached to the tunica albuginea, and freely movable under the skin. These are the scars of small hæmatomata, resulting from minute lacerations, which were practically symptomless.

Most of these patients give a history of one or more attacks of gonorrhœa, and in these it is found that the inflammatory process has spread outside the urethra, and has infiltrated the fibrous septa, and so formed a locus minoris resistentiæ for the occurrence of these lacerations. Infection of the hæmatoma is rare, and if it should become infected, the matter may become very serious: gangrene of the tissues may take place, and sloughing occur.

The lesion occurs almost always during coitus; it has been known to occur during masturbation. At the moment of happening, a distinct cracking noise may be audible; there is sudden intense pain, and the organ immediately becomes flaccid. Within a few minutes, however, it begins to enlarge, and attains a perfectly enormous size. This is due to the associated œdema. The primary pain is succeeded by a painful sense of fulness. Ecchymosis is very marked. The lesion is typical: the organ bent on itself, the enormous size, the subcutaneous extravasation of blood. The absence of bleeding from the meatus distinguishes it from laceration of the urethra.

The line of treatment followed out in the past has generally been an expectant one. The patient has been kept in bed, and cold compresses have been applied locally. Fair results only have been obtained. Legueu and Michon recommend exposing the site of fracture, turning out the clots, and approximating accurately, by suture, the torn surfaces. They claim that no deformity follows, and there is better expectation of the penis regaining its power of erection.

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POST-OPERATIVE ILEUS.

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THE term "ileus" as applied to post-operative conditions may mean an obstruction to the onward flow of intestinal contents due to one of two causes: first, mechanical, which includes all kinks and twists in the bowel, adhesions constricting the lumen, strangulations by internal and external hernia and the like; second, paralytic, which in reality is not an obstruction but simply an inability of the bowel to propel its contents onward; in other words, a stasis.

The clinical pictures in both varieties are identical. The classical symptoms of pain, vomiting, meteorism and coprostasis are in each case the same. In the mechanical variety the cause is evident; in the paralytic it is as yet undetermined, for we do not know upon what factor or factors paralysis of a greater or lesser extent of the musculature of a bowel does depend. Infections, nerve interference, and extreme traumatism to the intestines with injury to the mesentery, sometimes causing thrombosis of its vessels, have been given as etiologic factors. Nor does this matter for our present purpose, for we are concerned, not with the cause of the paralysis, but with how to prevent the direful condition it produces from becoming rapidly fatal; in other words, how to overcome it, once it is present.

About five years ago, while experimenting on dogs to determine whether the anatomic site of the obstruction played a definite part in the time required to produce death, we were somewhat surprised to see that some of the dogs died without apparent signs of peritonitis. Later, at necropsy we observed this same condition in several cases of post-operative ileus. The interesting question was and is to-day, what is the direct

cause of death in these cases? Up to date an extensive literature has grown up on this subject, but there appears to be as yet no unanimity of opinion.

The theories advanced as a cause of death in ileus uncomplicated by peritonitis are, that it is an auto-intoxication due to an absorption of toxins from decomposing intestinal contents; that it is a bacteraemia of a septicæmia; that it is due to an absorption of an altered chemically toxic secretion of the duodenum; that it is due to a reduced blood-pressure, an exhaustion or a collapse, brought about by the enormous loss of fluids from the blood- and lymph-systems, caused by the increasing intestinal transudation, in time producing anæmia or a devitalization of important centres in the brain; or that it is a reflex phenomenon due to an irritation of the central nervous system.

The prevailing impression in regard to the cause of death in ileus seems to be that it is a toxic condition originating from the absorption of bacteria or their toxins or from the absorption of some altered physiologic secretions of the pancreas, liver and intestinal mucosa. If this is so, it ought to be possible, in some manner, to demonstrate such poisons experimentally.

For our experiments dogs were used. Obstruction of the bowel was performed high, that is about 8 inches from the pylorus or about 2 or 3 inches distal to the opening of the bile and pancreatic ducts.

Dogs with complete obstruction of the bowel at this point, uncomplicated by peritonitis, lived from 40 to 108 hours, the average time being about 69 hours. For from 30 to 40 hours after the obstruction was produced, the animal would move about. The clinical syndrome in each case was typical. There would be vomiting and after 40 hours the animal would lie down most of the time. Muscular tremors, localized in certain groups of muscles, would appear. A certain muscular stiffness could also be noticed in certain cases. The animal would remain between a semicomatose condition and death for two, three and even four days. The overfilled stomach would

often partly empty itself, not so much by an act of vomiting on the part of the dog but more properly speaking by an overflowing.

The temperature of an "ileus dog" was not characteristic. There would be a slight rise during the first and second days following the artificial obstruction, after which it would return to normal and quickly become subnormal. The temperatures were all taken by rectum. The normal temperature of a dog is from 101 to 102° F. It would rise to about 102.5 or 103° F. and on the third and fourth days and just before death it would not register over 92° F. The pulse was always accelerated somewhat. The pulse-rate ranged from 100 on the first day to between 120 and 130 on the third and fourth days.

In a series of five dogs complete blood examinations were made before operation and twice daily after operation. We thought that some definite change in the blood-picture might be noticed; but on finding this quite constant, not characteristic and not different from that which is observed in other conditions, we abandoned these entirely. There would be a slight leucocytosis at first, then a gradual fall to normal and subnormal.

With these brief preliminary remarks we shall now cite our experiments.

First Series of Experiments, Injections of Duodenal and Stomach Secretions.—The duodenal and stomach secretions, that is, the secretions above the point of obstruction, were tested as regards their toxicity. For this purpose guinea-pigs were used. The secretions were filtered first through porcelain filters. Cultures taken from the final porcelain filtrate still showed the presence of bacilli and cocci. Half of the filtrate of the secretion of each dog was then sterilized by heat at 100° C. (212° F.) for from thirty to fifty minutes. The other half was used without sterilization: 1.5 c.c. of the sterilized and 1.5 c.c. of the unsterilized filtrate were then injected subcutaneously into guinea-pigs. At the point of the injection of the unsterilized filtrate sloughs developed, but in no instance did the guinea-pigs show any evidence of toxæmia. For three or four days after the injection, the guinea-pigs seemed lively and normal. In all ten dogs and twenty guinea-pigs were used.

The amount injected, 1.5 c.c., is a small amount, but 1.5 c.c. for a guinea-pig would, weight for weight, be equivalent to about 360 c.c. (about 12 ounces) for a man weighing 150 pounds. Besides guinea-pigs, one dog

weighing 7 pounds was used. The intestinal contents were filtered through filter-paper, and with the filtrate as a diluent a 4 per cent. tricresol solution was made; 40 c.c. of this solution were then injected subcutaneously. (This amount, for a dog weighing 7 pounds, is equivalent to about 3.5 c.c. for a guinea-pig and 850 c.c., or about 28 ounces, for a man weighing 150 pounds.) This solution, if at all toxic, certainly ought to show its toxicity in some form or other when injected into animals in such large proportions.

Second Series of Experiments, Injection of Serum.—If the dogs died of toxæmia, the toxic material, whatever it might be, must be circulating in the blood-stream in order to cause its fatal effects. Whatever is in the stomach or bowel is, so to speak, outside of the body. For this reason the toxicity of the serum of the ileus dogs was tested. The first dogs were allowed to die, but, as after death it was difficult to withdraw a sufficient amount of blood from which to separate out the serum, the dogs used later were allowed to live 48 hours (at which time their symptoms seemed most severe) and then bled to death.

Cultures were made from the blood, serum and peritoneum of all these animals, and in each case in which the peritoneum showed an absence of bacteria the blood and serum gave the same negative result. When peritonitis was present (which animals were not used) bacteria resembling the colon bacillus and *Staphylococcus albus* could also be demonstrated in the cultures taken from the blood of these animals. Such positive results were not, however, constant. The serum of ten dogs was injected into twenty-five guinea-pigs subcutaneously and peritoneally. From 1.5 c.c. to 3 c.c. were used. Whether the intraperitoneal or subcutaneous injection was used seemed to make little difference. The guinea-pigs that received 3 c.c. died; about half of those that received 2 c.c. died and the others remained well and lively; only one of those that received 1.5 c.c. died.

In the process of the clotting of blood, the leucocytes, as is well known, are squeezed on and certain enzymes are forced out of their protoplasm. It was thought that the enzymes might have some neutralizing effect on the toxins circulating in the serum, if any such there are. For this reason the blood was prevented from clotting by allowing it to run, while bleeding, directly into a 1 per cent. solution of sodium citrate. Equal parts of blood and sodium citrate solution were used. The mixture was then centrifuged. Of this mixture of sodium citrate and serum, 4 c.c. were injected into six guinea-pigs. (Serum from three different dogs was used.)

This mixture had about the same effect as did the plain serum. One guinea-pig died; the five remaining continued lively and well. The guinea-pigs were observed for about five days and then released.

What was the cause of the varied outcome of these injections of "ileus serum"? Is dog serum a foreign protein for guinea-pigs and does the injection of such foreign protein cause anaphylaxis? If it does, normal dog-serum ought to have the same effect and this, we learned later, is precisely what normal dog-serum will do. Testing normal dog-serum on guinea-pigs we found that over 2 c.c. will invariably kill; that 2 c.c. and

even 1.5 c.c. sometimes kills. This is exactly what the serum from the "ileus dogs" had been doing.

Instead of guinea-pigs, small dogs were now used. Of course, the amount of the corresponding injection had to be increased. The equivalents of from 2 to 4 c.c. to a guinea-pig weighing 300 gm. were injected. One dog weighing 7 pounds received 40 c.c.; one dog weighing 10 pounds received 50 c.c. and another weighing 14 pounds received 40 c.c. As far as could be observed, these injections of serum from ileus dogs into normal dogs had absolutely no effect. In like manner two rabbits were used with a negative result.

Third Series of Experiments, Injections of the Supposedly Toxic Gas Elaborated in the Stomach and Intestines.—At intervals varying from 48 to 60 hours after the artificial obstruction, a series of seven dogs was killed; 140 c.c. of gas by volume were extracted from the stomach and duodenum with an old-fashioned screw plunger aspirator, and the whole (that is, 140 c.c.) injected into the intraperitoneal cavity of normal dogs weighing, on an average, 25 pounds. The absorption of this gas, as we detected from subcutaneous injections in another series, is completed in about 24 hours. In no instance did the recipients of the gas show signs of toxemia. Their temperature became slightly elevated for a few hours, but aside from this the findings were negative. There were no evidences of either vomiting or of peritonitis. These dogs seemed normal in every way. They were observed for six days and then released.

If in ileus there is an absorption of toxins, where are the toxins? Toxins, in order to have a deleterious effect on the body, must reach the central nervous system, at least the respiratory and circulatory centres; and how can they reach these centres if they are not brought into contact with them by the serum of the blood? Can they be contained in the corpuscular elements of the blood? If so the introduction of a large amount of a supposedly toxic blood, *en masse*, into a normal animal ought to produce some symptoms in that normal animal corresponding to those it produced in the abnormal animal from which it was taken. This again we were unable to demonstrate in a fourth series of experiments.

Fourth Series of Experiments, Direct Transfusion of Blood.—The carotid artery of an ileus dog was exposed 48 hours after the onset of ileus. The jugular vein of a normal dog was next exposed and 50 c.c. or nearly 2 ounces of blood were withdrawn. A cannula was then connected from the carotid artery of the ileus dog to the jugular vein of the normal dog and the former bled to death into the latter. The normal dog was carefully weighed immediately before and immediately after each transfusion,

for by this method alone we were able to judge just how much "ileus blood" it received. This procedure was repeated seven times. In the first three cases both dogs were anæsthetized with ether, but the ether anæsthesia, in itself a toxæmia, caused vomiting and stupor and therefore interfered with correct deductions; local anæsthesia was then used, and in every case after the transfusion was completed the dog would jump up, be as lively as before and continue in the same state, absolutely normal. The amount of blood the normal dog received varied somewhat. As will be seen from Table I, the average weight of the recipient dog was $13\frac{1}{2}$ pounds and the average amount of ileus blood he received was $13\frac{3}{8}$ ounces.

TABLE I.—RESULTS IN EXPERIMENTAL DIRECT BLOOD TRANSFUSION.¹

Weight of dog before transfusion.	Weight of dog after transfusion.	Amount gained after 50 c.c. or 2 oz. blood withdrawn.	Amount in c.c. of ileus blood normal dog received.
<i>Pounds</i>	<i>Pounds</i>	<i>Ounces</i>	<i>c.c.</i>
17	$17\frac{1}{2}$	10	300
15	16	18	540
15	16	18	540
13	$13\frac{3}{4}$	14	420
10	$10\frac{1}{4}$	6	180
11	$11\frac{1}{2}$	10	300
15	16	18	540
Total..96	101	94	2820
Average..13.7	14.4	13.4	402.8

The largest amount was 540 c.c. (18 ounces) and the smallest was 180 c.c. (6 ounces). The normal amount of blood in a dog weighing 13.5 pounds, the average weight of the recipient dog, is about 15.4 ounces. By volume, therefore, the amount of ileus blood (402.6 c.c. or $13\frac{3}{8}$ ounces) the recipient dog received was 2 ounces less than the normal amount of blood contained in that dog.

If the ileus blood which the normal dog received contained some toxic substance surely the reception of such a large amount ought to cause symptoms similar to those observed in the ileus dog. This was not the case. There was not even vomiting and the dog soon after apparently ate a hearty meal. It might be interesting to observe that the average amount of blood the dog received in the transfusion would, in a man weighing 150 pounds, be equivalent to $4\frac{1}{2}$ quarts.

After reviewing these experimental facts can we still hold that death in ileus is due to a toxæmia? We have been unable to demonstrate bacteria in the blood, and likewise by injecting the duodenal and stomach contents, by injecting the serum, by injecting the gas elaborated, and lastly, by direct transfusion

¹ McLean and Andries, Journal A.M.A., Nov. 2, 1912, page 1614.

of the blood, we have also been unable to prove the presence of bacteria or any other toxic substance. Besides this, absorption from the bowel in ileus is considerably diminished. Braun² has proved this very conclusively by injections of solution of strychnin sulphate into the proximal portion of the bowel. He concludes that absorption of the strychnin is less rapid than normal even from the onset of ileus. (He based his deduction on the intervals between the injections and the appearance of convulsions and death.) In some cases the progressive diminution in absorption is so great and the consequent absorption of strychnin so slow, that the injection of more than a toxic dose of strychnin will not cause convulsion and death. In other words, in spite of the excessive dose of strychnin, the animals expire as usual from induced ileus and not from strychnin poisoning. From these experiments he concludes that in ileus the absorption from the bowel is lessened in all cases and in some stages of the disease is entirely absent.

If an ileus death is not due to toxæmia, to what is it due?

A striking thing that was noticed in the animals that died of an experimental ileus is the loss of weight (see Table II).

TABLE II.—AMOUNT OF WEIGHT LOST IN THE COURSE OF AN ILEUS DEATH.

Time in which death occurred.	Weight before operation.		Weight 2 hours after operation.		Weight 24 hours after operation.		Weight 48 hours after operation.		Weight 72 hours after operation.		Weight 96 hours after operation.		Weight 108 hours after operation.		Weight at death.	
hours	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
75	26	4	25	8	25	..	24	..	21	8	*	*	21	*	21	8
108	25	..	22	12	21	8	21	8	21	..	19	*	19	*	19	..
72	15	..	15	..	15	..	14	..	13	..	*	*	13	*	13	..
48	21	..	21	..	19	..	17	8	*	..	*	*	17	*	17	8
48	11	..	11	..	11	..	10	8	*	..	*	*	10	*	10	8
60	14	8	13	8	..	..	12	..	*	..	*	*	12	..	12	..
72	15	4	15	..	14	8	13	..	12	..	*	*	12	..	12	..
40	44	8	41	4	..	..	38	12	*	..	*	*	38	12	38	12
72	21	..	21	..	..	..	20	..	19	..	*	*	19	..	19	..
72	22	..	21	..	..	..	20	..	19	8	*	*	19	8	19	8
72	20	..	19	..	..	..	17	..	16	8	*	*	16	8	16	8
Total.... 739	235	8	225	..	..	..	208	6	..	..	..	..	199	4	199	4
Average.. 67	21	2	20	1	..	..	18	15	..	..	..	..	18	1	18	1

² Braun, Ztschr. f. Chir., 1908, xcvi, 544.

* Dead.

The dogs lived from 40 to 108 hours, an average of 67 hours, and during that time the weight lost was from 1 to 5½ pounds, the average being a little over 3 pounds. Some of the dogs had a full stomach at the time of operation, and if we deduct the weight of the vomitus during the first two hours after the operation, that is, the amount of food débris contained in the stomach at the time of the operation, the average amount of weight lost would be 2 pounds.

For animals weighing on the average of 20 pounds, that is, the average weight of the animal two hours after the onset of ileus, the loss of 2 pounds is quite considerable. It is a loss of about one-tenth of the whole body weight. This in a man weighing 150 pounds would be the equivalent to a loss of 15 pounds and that in the short space of three days. This loss of weight must be attributed principally to a loss of body fluids that have been discharged through the bile passages and pancreatic ducts and that have otherwise transuded through the intestinal mucosa, and have been expelled as vomitus and urine.

When we consider that the proportion of blood to the other elements of the body is, weight for weight, about one-fourteenth, and that the loss in ileus animals is about one-tenth, all due to the loss of fluids, then we can readily understand how this must have a detrimental effect on all the body functions. It must certainly have an enormous effect on the blood-pressure.

We have not conducted any experiments on the blood-pressure of dogs dying from ileus, but Braun² showed very conclusively by a long series of experiments that the death of dogs that died from ileus without peritonitis differed in no way from that of those that were bled to death slowly. Besides the blood-pressure, which in each case was similar, the general clinical picture, he asserted, except for the vomiting in ileus animals, was also similar. Accordingly, the disordered functioning power of the bowel, with its direct depleting effect on the abdominal blood-vessels and consequently on the whole vascular and lymph system, causing a steady sinking blood-pressure, and a necessary consequent disturbance in the cerebral

circulation, most evident in the circulation of the vital centres, can be looked on as one of the prime factors of the direct cause of death in ileus.

Hartwell and Hoguet³ have demonstrated the fatal effect of loss of fluids in ileus most conclusively by a series of experiments in which life of ileus dogs was sustained indefinitely by the subcutaneous injection of saline. To quote from these authors: They conclude "that if a quantity of normal saline solution, slightly in excess of the total loss of water in the urine and vomitus, be given daily in the form of hypodermoclysis, the ileus dogs promptly return to the condition of a dog undergoing simple starvation. Dogs so treated have lived in excellent health for a period of three weeks and more, showing at the end of that time every indication that they would have lived much longer if the treatment were continued."

Besides this loss of fluids, the sympathetic nervous system must play an important rôle. If a severe blow on the solar plexus can occasion death, is it not probable that such grave changes as are caused by ileus in the abdominal viscera, the organs directly supplied by the sympathetic or solar plexus, may set up similar reflexes with a similar result? Of course, concerning the sympathetic nervous system little is known definitely and absolute proof of the effect of ileus on this system is wanting. That such a hypothesis may be correct we will not deny. That a toxæmia, however, is the cause of death in ileus in the face of the experiments enumerated, is hardly tenable.

Interesting as it is to know exactly on what factors death depends, such knowledge is at the same time practical. In the beginning we stated that we were concerned in preventing the direful condition ileus produces from becoming rapidly fatal. This can be done in a large percentage of cases if a practical application of the knowledge, gained by our experimental studies, is made. If we look on the disturbed functioning power of the bowel and the failing circulation that results there-

³ Hartwell, John A., and Hoguet, J. P.: Experimental Intestinal Obstruction.

from as the source of the clinical picture of ileus, then our efforts must be directed toward these factors. Rational treatment must therefore, first, subdue the distention, which is continually increasing and at the same time increasing the paralysis of the bowel, in the same manner as overdistention of the bladder brings on a paralysis of the musculature of this viscus, and, secondly, it must replace the lost fluid in the vessels. The former condition, the distention, can often be relieved in mild cases by stomach lavage and enemas, but in severe cases, surely by ileostomy. Ileostomy, by relieving the distention in practically an instant, allays at the same time the irritation in the paralyzed gut and so inhibits the further influx of blood to the abdominal blood-vessels; the latter condition, the lost fluid or the exsanguination that has taken place, can only be restored by a refilling of the vascular system. This can best be accomplished by the free administration of saline solution intravenously and subcutaneously and fluids by rectum.

In our general surgical practice during the past three years we have been adhering to these rules very closely. With free use of saline and early enterostomy we believe that we have saved 65 per cent. of cases of severe ileus, that is, cases we feel sure would have terminated fatally had we not resorted to these measures. Our cases of ileus in almost all instances have been confined to the small intestines, and strange to say, have always followed operations performed in the lower abdomen. This we believe is due to the fact that in operations in the upper abdomen there is practically no disturbance of the small intestines and its mesentery.

In our work we usually make two practical divisions of ileus. These divisions are: aseptic or noninfectious and the infectious or ileus accompanied by peritonitis.

When ileus is complicated by peritonitis or *vice versa* if you will, peritonitis complicated by ileus, it is not so much the peritonitis that proves fatal; it is the ileus. Formerly we attributed the death in these cases as due to the septic peritonitis but now we know that if we overcome the ileus, if we subdue the distention and stop the regurgitant vomiting by ileostomy,

the patients will usually recover: with proper drainage of the peritoneal cavity they will in a large percentage of cases survive the peritonitis.

During the past year we have gone still further. We have anticipated postoperative ileus, and in the very severe cases have performed an ileostomy at the primary operation. The cases in which a "primary ileostomy" was done were appendix cases. These were all cases with marked distention, regurgitant vomiting and coprostasis, with anxious, pinched, drawn facial expressions and labored breathing; cases really *in extremis* in which we hoped against hope. Yet with the ileostomy, performed at the time of the removal of the appendix and the subsequent administration of saline, all three of these cases recovered. We feel sure that had we not performed the primary ileostomy in these cases, each would have proved fatal. Three cases is of course a small number to judge from, yet we felt so encouraged by the results of these cases that we intend in the future to continue the use of this measure as a life saver. We strongly recommend it to those who have not given it a trial. If at all possible these operations should be performed under local anæsthesia.

The subsequent closure of the ileostomy wound is simple. All that is necessary is to free the bowel from its parietal peritoneal attachment and after closing the opening with a simple suture of catgut and a Lembert suture of linen, it is dropped back into the peritoneal cavity. A small gauze drain is inserted down to the sutured gut and left there for forty-eight hours.

SUMMARY.

1. Death in ileus, so far as we can determine, is not due to toxæmia, that is, it is due neither to the absorption of bacteria nor their toxins nor to the absorption of some altered physiological secretion.

2. A depletion of the vascular and lymph systems causing a grave disturbance in the circulation, especially in the cerebral circulation, is a prime factor in the causation of death.

3. A pathologic change in the sympathetic nervous system, a loss of sympathetic control, is probably contributory.

4. Ileostomy at the primary operation should be resorted to in all the severe cases of peritonitis with overdistention of the abdomen. These operations should, when possible, be performed under local anæsthesia.

5. It is our opinion that many patients suffering from peritonitis and ileus die, not of the peritonitis, but of the ileus.

6. All treatment must be directed to the relief of the distention and to the refilling of the depleted vessels for which ileostomy and the free use of fluids are our sheet anchor.

INTESTINAL OBSTRUCTION RESULTING FROM A MALIGNANT TUMOR OF A RETAINED TESTIS ABDOMINIS.

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THE importance of examining the scrotum in tumors of the abdomen was brought to notice in my article in the *Practitioner*, April, 1912. Some time later to my writing that article I met with a case of intestinal obstruction in which the post-mortem examination revealed the presence of a malignant tumor of a retained testis abdominis. It is true that retained testicular tumors are rare and still rarer for them to give rise to the typical symptoms of intestinal obstruction, but it is also true that an overlooking of the scrotal examination leads in diagnosis to serious errors which can be easily avoided. The diagnosis of the condition might not save the patient's life, but we may surely avoid adding one more to our mortality register. That is my only plea for reporting the following case, which also illustrates how such retained testicular tumors may give rise to no serious symptoms until they attain enormous dimensions, when their removal by an operation is quite out of the question.

The patient was a Hindu, male, aged twenty-six years. He gave a history of constipation for 4 or 5 days previously. It was accompanied by severe pain in the abdomen and vomiting. The patient was a ryot and said that until the present illness he was in sound health and daily working in the fields. When he came into hospital he had a very anxious look and a typical acute abdominal facies. The abdomen was distended and its wall rigid and board-like. There was much tenderness on palpating the abdomen. The lower extremities were flexed to relax the anterior abdominal wall. The temperature was about 101° F. and the pulse quick and thready. The case was suspected to be one of intestinal obstruction. Laparotomy was done, when a huge inop-

erable tumor was seen inside the abdomen. The operation wound was closed and the patient sent to bed. He died a few hours later.

The post-mortem examination was conducted by Major H. Kirkpatrick, I.M.S. and myself. The absence of the testicle on the left side of the scrotum was noticed. A bluish cord occupied the left inguinal canal. Its extremity ended in the fascia of the thigh and could be traced up the abdomen in the direction of the spermatic veins. An enormous mass of growth about the size of a man's head occupied the hypogastrium. Its contents were partly fluid. The bladder was stretched up in front and a coil of the colon was attached to it above the pelvic aspect of the tumor. The ureters on each side were enormously dilated and lay on either side of the tumor. The kidneys were very hydronephrotic. Between them was found a mass of growth having the interior vena cava on its right side and the aorta behind. This secondary growth was friable in consistency, on section mottled and streaked with dark red and gray lines and not unlike an organizing thrombus. Its shape was roughly rounded and surface irregular. The primary tumor in the hypogastrium consisted of a semifibrous wall containing a softened semifluid mass of material which was highly hemorrhagic. It resembled a softened mass of brain substance. At the lower pole of the tumor and to its left side was situated a more solid mass. This was about the size of a large hen's egg and had a firm capsule but its substance was soft and friable. On section it was mottled with red and gray areas.

The other organs were normal. No secondary growths were seen in any of them.

A microscopical examination of sections taken from different parts of the tumor was conducted. The growth was mainly necrotic and showed extensive areas of hemorrhage. In the less degenerate portions the growth was seen to be composed of large, mostly rounded, cells with a fair amount of protoplasm containing a large circular nucleus, which showed active division in places. The cells were found scattered in a loose network of fibrous tissue which was very highly vascular, showing a large number of dilated vessels full of blood. The tumor was malignant and of a sarcomatous type. No remains of any testicular structure were seen in the sections made.

Evidently the symptoms of intestinal obstruction were due to the enormous size of the tumor, which, I am of opinion, had originated in a testis retained inside the abdomen.

This case differs from the one reported by me as "a chorion-epitheliomatous tumor of a retained testis abdominis" in the *Practitioner*, May, 1913, in that in the latter there were no symptoms of intestinal obstruction, the tumor being therefore clearly felt in the lower part of the abdomen, occupying the pelvis; the post-mortem examination revealed multiple metastatic growths and the tumor was structurally of a chorionepitheliomatous type.

I have to thank Major H. Kirkpatrick, I.M.S., for the permission given me to record this case of interest.

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OBSTRUCTIVE PELVIC LESIONS ASSOCIATED WITH CHRONIC DIVERTICULITIS.*

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THE attention of surgeons has been directed of recent years to diverticula of the intestine as a cause in certain previously very obscure chronic indurated conditions. Suspicions of tuberculosis or syphilis, but especially of carcinoma, have led to exploratory operation, the pathology being finally determined as that of chronic diverticulitis. Often after most difficult dissection drainage of a small abscess in the centre of a rigid induration has been the only treatment possible. Curative treatment has required excision or resection of the bowel, a matter of much technical difficulty at times. Among the last 800 intra-abdominal operations by the writer five cases of various forms of diverticulum have been encountered, some of minor consequence, others of much gravity. They were as follows:

CASE I.—*Meckel's Diverticulum*. Incidentally observed while operating for extra-uterine pregnancy. It was a cone-shaped offshoot of the lower ileum. As its opening was large and there was no danger of subsequent strangulation it was treated by inversion and suture. Probably it had not caused symptoms. Patient was delivered normally a year later.

CASE II.—*Meckel's Diverticulum*. Acute obstruction of ileum. Boy of twelve years. Subsequent to recovery from typhoid fever two attacks of partial obstruction in previous months had been spontaneously relieved. The existing attack had gradually developed into complete obstruction and paresis which caused death thirty-six hours after operation, which was done too late and under unfavorable conditions. A strong broad adhesion band had strapped down an inch or more of small intestine to the root of

* Read before the Philadelphia Academy of Surgery, December 1, 1913.

the mesentery at a point immediately below the origin of a Meckel's diverticulum. The latter was enormously swollen as was the nearby gut above. The diverticulum had apparently participated in the production of the obstruction due to kinking above the broad adhesion.

CASE III.—*Multiple Diverticula of Sigmoid Bowel.* Mrs. X., aged sixty, presented symptoms suggestive of pelvic carcinoma. In addition to benign uterine hyperplasia the lower sigmoid bowel was rigid and leathery. After resection the gut was shown to be pierced by numerous diverticula. Inflammation had extended from these to surrounding tissues (see ANNALS OF SURGERY, vol. lvi, p. 661).

CASE IV.—*Diverticulitis of Rectum.* Mrs. B., aged sixty-three, had suffered from pelvic inflammatory attacks, for years, and at times had been treated by various specialists, receiving the rest cure, etc. Operation showed broad ligaments, very small ovaries and tubes buried in very firmly organized old adhesions which also surrounded the rectum. While the entire rectum had not the rigidity and leather-like feel at times noted, there was a diverticulum readily accessible resembling a thick short epiploic appendage with a firm club-shaped head as large as a cherry. This contained a movable mass, continued pressure on which caused it to be extruded into the lumen of the rectum. The offshoot from the bowel then collapsed, showing it to be diverticulum. Deeply situated in the cellular tissue surrounding the rectum were several firm bean-sized indurations which probably represented other diverticula, though only the one was clearly demonstrable. Diverticulitis was doubtless the cause of old obscure pelvic symptoms.

CASE. V.—At intervals of several months during the past year I have operated for recurring intestinal obstruction under conditions which interested me greatly. The patient presented a most baffling and formidable combination of pelvic conditions, at first supposed to be carcinomatous but which were finally shown to be associated with one or more diverticula lying in an inextricable mass of indurated tissues and organs against the sacrum.

The extensive destruction and disarrangement of pelvic anatomy was remarkable. The patient, aged forty-three, short, muscular, fat, weighing 190 pounds, was admitted for an attack of intestinal obstruction which proved to be incomplete. Owing to distention little could be learned by examination above the pubis ;

below the pelvis was found blocked by a large rounded fixed mass, apparently incorporating both uterus and rectum high up. There was a history of menorrhagia, and at long intervals slight discharge of mucus, so-called, but no blood from the rectum. There had been occasionally wire drawn stools for five years.

Operation was most unsatisfactory; an irregular, very hard pelvic mass inextricably incorporated the rectum and uterus with adherent coils of small bowel. After patient dissection nothing was accomplished except the release of a few adhesions, and in the apparent presence of malignancy the colon was attached to the left parietes, to be opened later when necessary. Strange to say, obstructive symptoms entirely disappeared following this operation, and large, well-formed stools were passed. All appearance of wire drawing disappeared, doubtless due to rectal drainage of a fluid sac and release of external pressure on the rectum. This relief continued for four months, the patient becoming apparently well. Wassermann test was negative and full doses of iodide of potassium used experimentally had no effect on the tumor. Then obstruction occurred gradually, became complete, and the colostomy was completed with immediate relief. Again she resumed the use of the rectum intermittently. The colon opening might be unnecessary for weeks, when it would again come into play. There was no valve action and no slack in the attachment of the colon. Six months later and nine months after the first operation, as the general condition seemed absolutely to negative the presence of carcinoma, I yielded to the solicitation of the patient to again try to remove the obstructive mass and make possible the closing of the colostomy. The attempt was again very disappointing and unsatisfactory. After the most difficult dissection a rounded pus sac with walls half an inch thick and very firm was traced behind the rectum, but it could not possibly be dissected out and had to be abandoned to drainage. Before opening it pressure did not cause it to drain into the rectum, though doubtless this occurred at times. The rectum where it emerged above the extremely hard mass was stiffened and the local vessels were deeply engorged. The microscope afterward showed no mucous membrane lining this pus sac, but it might have been destroyed by suppurative processes during years. I consider this sac to have been a diverticulum holding about three ounces of mucus, and so surrounded except on the rectal side by absolutely rigid tissue that when full it produced obstruction by compression,

relieved spontaneously or otherwise at intervals. A second focus was isolated from very hard tissue and finally detached, almost by fracture. It was found to be lined with mucous membrane. Its site was closed in by celluloid thread. No determination could be made of the kind of intestine from which it sprang but from its situation it was supposed to be also a diverticulum from the large bowel. The laboratory examination by Dr. Pfeiffer showed it, however, to contain glands unquestionably from the small intestine. It was, therefore, a Meckel's diverticulum, lying deep in the pelvis and caught in the general mass. With the greatest difficulty could the uterus be found, well in front. Large cigarette drains were placed in the diverticular pus cavity and another at the suture site of the Meckel's diverticulum. There was a troublesome oozing of indefinite origin which set in after reaction and which contributed more or less to the death by exhaustion after three days. Gas was passed by the colostomy.

The occurrence of five diverticula in such a small group of abdominal operations as 800, while probably only a coincidence, would seem to indicate that the abnormality may be more frequent than is supposed. Detection of short diverticula is difficult and when buried in dense, inflammatory tissue may only be possible after resection of the intestine. Certain it is that the lesion has been often overlooked in the past, especially in the sigmoid and rectum.

Device for Temporary Gas-Tight Plugging of Colostomy During Operation on the Abdomen Elsewhere.—Owing to the recurrent attacks of obstruction and the uncertainty of being able to remove the cause, it was necessary to operate without permanently closing the colon in the last case cited. The opening was therefore plugged by a finger cot of heavy type, passed part way in, then loosely packed with gauze both within and without the fistula so as to make a retention button. The cot was then tied to a catheter and inflated with air. This made a perfectly gas-tight valve, not affected by fluids or gentle manipulation. I reported the use of the same device to the Academy of Surgery in 1909 (see *ANNALS OF SURGERY*, vol. li, p. 425), when it was applied to a vesicovaginal fistula. Before removing a bleeding kidney tumor it was necessary to prove the function of the other kidney, which was impossible with a bladder collapsed by the presence of the fistula.

The distended rubber cot, however, made a watertight joint and made the cystoscopy perfectly easy. Unless a little gauze is put inside the cot before inflation, the air may all go into one end of the device, which would then slip out.

ARTHROPLASTY.

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It may be laid down as axiomatic that, where there are many cures for an evil or various remedies for a disease none is entirely satisfactory. Many standard operations, so to speak, are well nigh perfected, but a special method of operation for the relief of ankylosed joints has not been universally agreed upon. Failures as well as good results in such cases should be reported, as by such a course alone will we be able to reach a sound conclusion. Various methods have been used in attempting to mobilize ankylosed joints, and it is interesting to note the development of the operation.

In 1826, J. Rhea Barton¹ of this city performed an osteotomy for an angular true ankylosis of the hip-joint. He divided the bone through the great trochanter and a part of the neck of the femur; then prevented bony union by movements. In 1830, Rodgers² of New York modified Barton's operation by removing a disc of bone from between the trochanters, and in 1840, Carnochan³ attempted to prevent bony union after he had accidentally fractured the maxilla while operating for ankylosis. He interposed a piece of wood between the bony surface. In 1860, Verneuil⁴ interposed a piece of temporal muscle and fascia between the condyle and the glenoid in a case of ankylosis of the jaw. Twenty years ago, Helferich⁵ performed a similar operation on a child one year old; and after resecting the condyle of the inferior maxilla inserted a flap from the temporal muscle between the articulating bones. Since that time, this operation has undergone various modifications. In 1895, Mikulicz⁶ used practically Helferich's procedure but employed a flap from the masseter instead of from the temporal. In 1901, Cramer⁷ operated upon ten cases of ankylosis of the patella by the interposition of a piece of vastus internus; of these ten cases six were successful. Orlov⁸ in the same year attempted the use of metal plates and gold foil as the intermediate body and this procedure was followed by the use of other non-absorbable materials such as plates of celluloid, zinc, silver, cambric, collodion and rubber.

With these agents an occasional good result was obtained, but in the great majority of cases a few months after operation

the foreign material was extruded from the joint and ankylosis returned.

In 1907, Weglowski⁹ transplanted with success the cartilage of a rib in a case of ankylosis of the elbow. Chulmsky,¹⁰ in 1902, tried to use decalcified bone, magnesium and ivory but they all became absorbed and ankylosis returned. He deduced, however, that as false joints or pseudarthroses in ununited fracture of long bones were formed of aponeurosis and fatty tissue, the same tissues could be used in the formation of a new joint in a case of ankylosis. In the same year Nélaton¹¹ operated upon two cases of ankylosis of the hip-joint by interposing a strip of fascia lata between the head of the femur and the acetabulum. In 1905, Murphy¹² reported twelve cases in which he interposed fascia and muscle covered with a layer of adipose tissue to produce, to quote him, "Normal movable joints with capsules and collagen intra-articular fluid." By this method hygroma-bursa formation is sought. The formation of hygroma being "the result of a degenerative or absorptive process in fatty tissues with hyperplasia of the connective tissue element, the segmentation of the collagen into solution, 'fibrinoid', a liquefaction of hypertrophied connective tissue." His first operation of this character was performed in 1901. In 1909, Baer¹³ made a preliminary report on the use of animal membrane in securing mobility in ankylosed joints. He used pig's bladder "which is chromicized so as to remain intact about forty days." The pig's bladder is boiled in cumol. Osgood has reported several successful cases operated upon by this method. Baer also used Cargile membrane or the peritoneum of an ox, as the interposing agent but found that it was absorbed in a period of ten to fifteen days and therefore not useful. This method of using animal membrane had been attempted before by Foderl, who, in experimenting on animals, interposed between the bones pieces of bladder and also the wall of ovarian cysts.

This is but a partial list of those who have contributed to the development of the operation.

When should operation be performed in a case of ankylosis?

For practical purposes ankyloses may be divided into two main divisions: the false, periarticular or extra-articular, and the true, articular or intra-articular. Murphy sub-divides the periarticular into capsular and extracapsular; and the articular into synovial, fibrous, cartilaginous and osseous.

The main treatment should, of course, be preventive, that is, one should attempt to guard against ankylosis of a joint which has been the site of an infectious or traumatic arthritis. There are exceptions, however, even to this rule, as in tubercu-

lous affections of joints ankylosis is often most desirable. In such cases or in cases where ankylosis is inevitable the aim should be to obtain a position which will render the part most useful. Baking, massage, passive movements, brisement forcé with an anæsthetic, tenotomy, myotomy, tendoplasty or myoplasty, excision of tendon sheaths, or cicatrices, are all methods employed in relief of periarticular, extra-articular, or false ankylosis.

Should some form of open operation be attempted in intra-articular ankylosis? This naturally must depend upon the cause of the ankylosis, the joint affected and the present usefulness of the part. One hesitates to open a joint which has been the site of a tuberculous infection, because, although the infection may apparently be dormant, operation and the subsequent passive movements may cause the infection to take on renewed activity. Many such cases have, however, been successfully operated upon, among which is the case to be shown to-night. The X-ray is of course valuable, but not absolutely final, in showing if the infection is still active. Hesitancy is unnecessary if the ankylosis is due to trauma such as fracture or to infections such as rheumatism, gonorrhœa, etc.

The mandibular joint offers the best field for operation. First, because of the favorable prognosis, second, because of the immense importance to the individual of mobility in this joint. Fortunately ankylosis of this joint, which follows severe forms of stomatitis and noma, is usually extra-articular and mobility can be usually obtained by relieving the periarticular cicatrices. When ankylosis is intra-articular arthroplasty can be performed and either a flap from the temporal or masseter muscle or chromic pig's bladder can be used for the formation of a new joint. The latter has been successfully used by Brackett.¹⁴

From the reports of cases in literature it would seem that the future use of these interposing tissues may depend upon the joint involved. It would seem possible that the Murphy operation will continue to be used in the knee-joint and in the hip-joint. In these joints, which are joints of locomotion, and

which carry the weight of the body, hygroma formation is necessary or at least desirable and Murphy's operation leads to a hygroma or formation of a new bursa. On the other hand, in the elbow, shoulder and the mandible a wide range of mobility is desired; there is no weight born by the joint and it would therefore seem that the formation of hygroma is not essential; therefore, the use of Baer's membrane is the preferable material for interposition. The technic of the interposition of this membrane is considerably easier than the technic of the Murphy operation.

In the hip-joint any position of ankylosis must be not only an inconvenience but an actual interference with one's ability to earn a livelihood. It should, therefore, offer a good field for arthroplasty. The same may be said of ankylosis of the shoulder.

In ankylosis of the knee and elbow, however, it would seem in the light of our present knowledge and experience that one should not too hastily fly to operation.

Even according to Murphy's own statistics the elbow and the knee offer the poorest prognosis of any joints. Therefore, if a patient has intra-articular ankylosis of a knee-joint, the ankylosis being with the leg in extension, there being no pain and the man or woman being able to perform his or her occupation, it would not seem that arthroplasty should be attempted without a full explanation to the patient of the facts that the operation will be followed by considerable pain, and that, whereas some motion may be obtained, it may be slight and ankylosis may recur.

The same might be said of the elbow. If there is ankylosis of elbow with the forearm at right angles to the arm, and if, in spite of the ankylosis the patient is able to earn a livelihood and the extremity is not painful the pros and cons should be carefully weighed before deciding on operation.

On the other hand, given a knee ankylosed at or near a right angle, or an elbow ankylosed in extension, positions which must of necessity be a great handicap, then it would seem that operation is entirely justifiable. Preferably arthroplasty should be

attempted, for, even if unsuccessful as to mobility, a better position can be obtained for possible subsequent ankylosis.

Illustrative Case.—A boy, now thirteen years old, was admitted to the Orthopaedic Hospital on October 11, 1912, in the service of Dr. William J. Taylor. The history was that of a tubercular arthritis of the right knee. Several operations had been performed merely for draining the joint. The condition of the knee was that of ankylosis of tibia, fibula and patella. The knee-joint was ankylosed at an angle of 45 degrees. There was no pain; no inflammation; no fever; all sinuses were healed.

Operation was performed by Dr. Taylor, November 8, 1912. A U-shaped flap was made with convexity downward. The skin flap was turned upward. The patella was sawn obliquely from above downward, and the joint was opened. All adhesions between the tibia and femur were freely liberated, the surface of the tibia and surfaces of the condyles cleaned of fibrous tissue and the capsule was cut away. By means of curved and straight chisels new and fresh surfaces were made. Sufficient bone must be chiselled away to allow for the interposing flaps and yet too much bone must not be removed for fear of obtaining a movable but weak joint.

Murphy has pointed out the necessity of keeping the intercondyloid ridge on the tibia intact to prevent lateral slipping of the femur.

The two interposing flaps were then cut; one from the external side, the other from the internal. They were interposed between the bones and sutured with No. 3 chromic gut. Because of the inability to get a good surface on the under aspect of the patella, it was turned over so that the normal anterior aspect became the posterior aspect. The wound was closed without drainage and the limb placed in a plaster case. This case was not removed for four weeks and no passive nor active movements were made until that time.

He was discharged from the hospital ten weeks after admission. He wore a supporting brace steadily for 6 months, then intermittently until end of a year.

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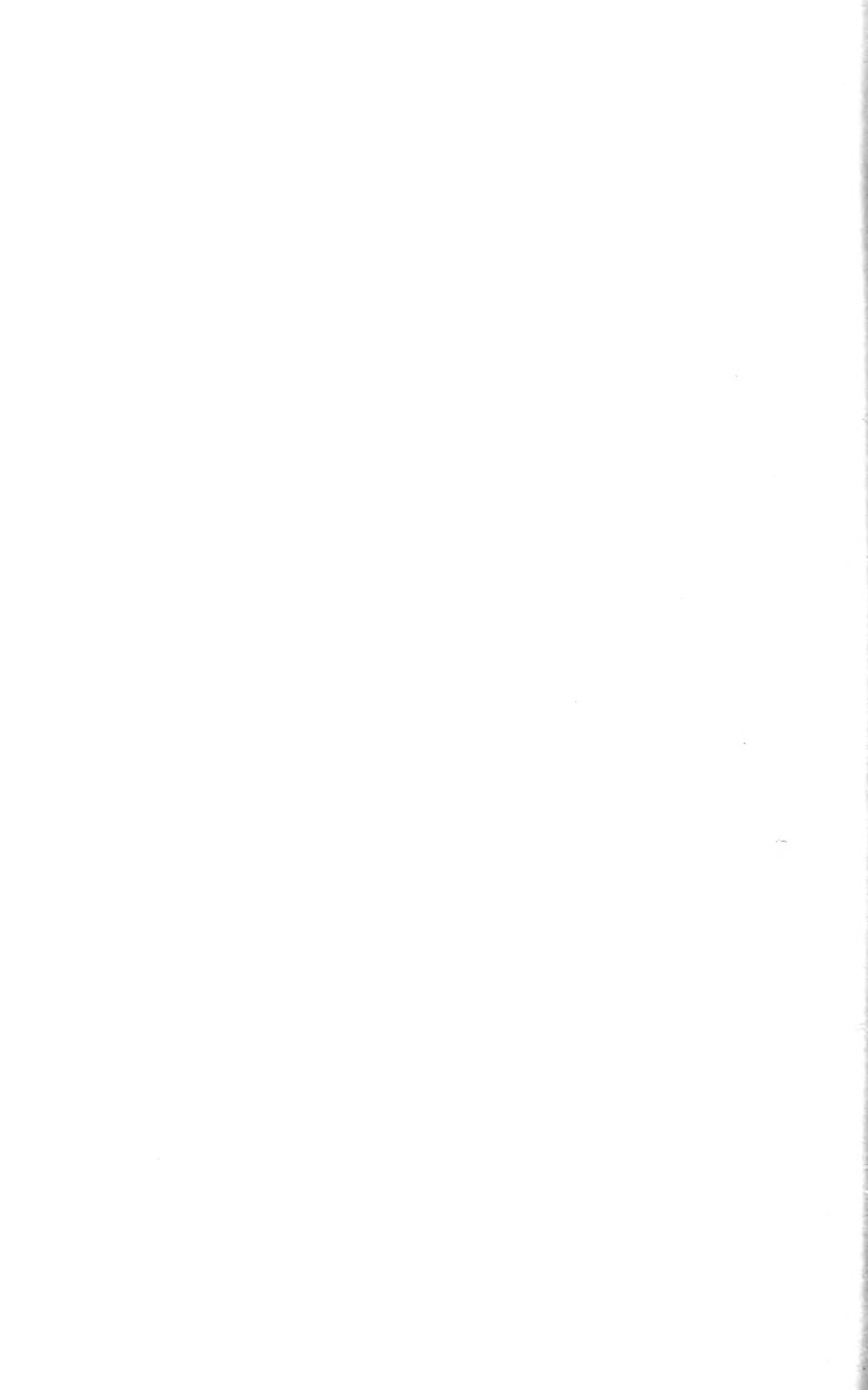
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³ Murphy (*ibid.*).

FIG. 1.



Result of arthroplasty on an ankylosed knee-joint. Flexion after operation.



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- ¹⁴ Papers from the Orthop. Dept. of Mass. General Hosp., May, 1912.

PARALYTIC TOE-DROP. PUTTI'S OPERATION FOR ITS RELIEF.*

WITH REPORT OF A CASE AND SLIGHT MODIFICATION OF THE TECHNIC.

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IN a survey of the deforming results of anterior poliomyelitis so far as the various joints are concerned, probably the most difficult of mechanical control is the hip-joint and next to it may be placed the ankle-joint, because of the range of movements of the foot when deprived of muscle control. Whether the loss of power be confined to the anterior group of muscles, or to the posterior group, or to both, the resulting deformity presents in many instances, a problem difficult of solution either mechanically or surgically. The multiplicity of forms of braces and the varieties of operations employed from time to time are the best evidence of the inefficiency of any one, and the constant effort of orthopædic surgeons has been to devise a means of correction which should prove reliable and permanent.

It must not for a moment be considered that every case of toe-drop or of calcaneus or of flail-foot following an attack of infantile paralysis is a proper one for operation, for it is not. Many paralyzed muscles recover power years after the attack, when the strain of position or function is removed from them, and the earliest and most essential factor in the treatment of these cases of paralysis is to put the parts at rest and remove strain from the weakened and inert muscles. This will favor the subsidence of inflammation in the motor cells of the cord, will check or lessen degeneration in these cells, will prevent the onset of deformity and the stretching of structures, and will also frequently be followed by return of power in muscles thought to be dead. After about six years have passed, how-

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ever, with careful supervision as to muscle strain, with massage and other local means to aid restoration of function, if paralysis still persists in a muscle or group of muscles, it is quite proper to consider this the real, permanent or residual paralysis and to institute surgical measures which will preserve the normal balance of the part for the performance of its functions in the best possible manner. Without such means, the patient is doomed to a life of brace-wearing which is always troublesome and at times extremely disabling through breaking of the appliance and inability to have prompt repairs made.

The surgical correction of paralytic conditions of the foot may conveniently be considered under four divisions: (1) Operations upon the bony parts; (2) operations upon the tendons and muscles; (3) operations upon the skin; and (4) operation by silk inserts in tendons or ligaments.

Under the first group is included arthrodesis of the ankle, transtarsal or tarsal joints. These operations have proven only partially successful. Great difficulty is experienced at times in securing firm ankylosis and where this does obtain, the part oftentimes proves painful for walking and the gait is a stilted one.

The second group received earliest consideration through the work of Nicoladoni, who in 1881 first practised transplantation of live tendons to assist or replace the paralyzed ones, and this was the first really great impetus to the surgery of paralysis. Many varied types of operation have been suggested and performed on these structures since then, such as shortening by tucking, by cutting out a section, by changing the point of insertion and by changing the angle of pull, by passing the tendon through a subperiosteal groove and fixing it there (Dr. W. E. Gallie, Toronto, Can., *ANNALS OF SURG.*, March, 1913, and *Amer. Jour. Orth. Surg.*, July, 1913). In all of these methods, the immediate results are good but in all excepting where the tendon of a live muscle is transplanted and where it is fixed in a subperiosteal groove, the deformity is extremely likely to recur, because the structures which stretch, viz.: the degenerated and paralyzed muscles, are still subjected to strain. Where they are eliminated as in the procedure reported by

Gallie, the results are sure and certain, as the tendons are converted into ligaments and do not stretch.

In the third group, Robert Jones has had good results from the resection of a portion of skin and fascia on the elongated side and bringing the edges together to maintain correction. This procedure when used in conjunction with tendon work affords reinforcement and lessens strain.

The fourth group has been extensively employed and is to be very strongly recommended. The results of the inserts of paraffined silk appear to be permanent, whether the parts reinforced be tendon or ligament. The only criticism to be offered against it is that silk is a foreign body, and if the same results can be secured by the use of living structures which are already in position and which are unyielding, I believe the local tissues should be utilized even though it is urged that the silk inserts rarely cause trouble by suppuration or otherwise.

In August, 1913, Dr. V. Putti, of the University of Bologna, Italy, performed for the writer another method of fixing these permanently paralyzed tendons which he has been using for some time with excellent results. The underlying principle is the same as that used by Sangiorgi (quoted by Gallie) and Gallie, viz.: to convert the tendons of the paralyzed muscles into ligaments, but Putti eliminates absolutely the degenerated muscle tissues which are the structures that stretch and permit the recurrence of the deformity and in this respect renders results more certain.

The operation for toe-drop with paralysis of the tibialis anticus, dorsal flexors of the toes and the peroneus tertius as done by Putti is as follows:

The tendo achillis is first made long enough (if not already so) to allow a right-angled position of the foot. An incision four or five inches long is then made from above the ankle-joint upward along the tibial crest and the anterior tendons exposed. These are separated and all are severed from their muscle attachments as high up as possible. The tibia is then freed about the middle of this incision and an oblong hole of sufficient size to receive all the tendon ends is mortised through it. The periosteum is next lifted from the front surface to the tibia. A tendon end is passed through the hole from one side and drawn taut, the foot being held at a right angle. Another tendon is next passed through from the other side

and the remaining tendons alternately until all are threaded. The ends are next drawn under the raised periosteum and firmly stitched in place to tendons, periosteum and tendon ends (Putti uses silk-worm gut sutures for this and leaves them buried) and the wound is closed. The parts are fixed for a couple of weeks by a splint; but Putti expresses himself as favorable to treatment without any support, believing that union will be much more firm if a little strain is permitted on the operated tendons and that we weaken the attachments by long continued fixation.

The mechanical features of the operation are entirely correct in the elimination of the weak and easily stretched muscle structures and conversion of the tendons (which stretch but little when continuous) into a large strong ligament having a sufficiently long hold on the foot and leg to give firm fixation and withstand quite a degree of strain. On November 21, 1913, I operated by this method upon a boy, S. M. (patient shown to the Academy), aged thirteen years, who had an attack of infantile paralysis over eleven years ago. There was complete loss of all the anterior muscles of the leg and foot with slight power in the plantar flexors of the toes and in the tendo achillis. There is also good power in the hamstrings, very slight power in the rectus femoris, and flexion of the knee to 15° .

After fixing the proximal ends of the severed tendons, as above described, the foot was maintained perfectly in the right-angled position and a plaster splint was applied to the entire leg, the knee being first forcibly straightened preparatory to a transplantation of the external hamstring into the patella.

In one feature, however, the operation impressed me as lacking and I shall correct this at the subsequent operation on this case. When the dorsal flexors are drawn taut, the toes stand out straight and would probably remain so if the plantar flexors were also paralyzed, but with these muscles alive and in action during function of the foot, it will be but a short while until the toes will become flexed through dropping downward of the metatarsophalangeal joints (from stretching of the fibres holding the dorsal flexor tendons to the top of the metatarsals and proximal phalanges), and the flexion of the distal phalanges of the toes and a condition of hammer-toe will be established

with dorsal dislocation of the toes upon the metatarsal ends. To obviate this, I propose to engraft the tendons of the dorsal flexors into the distal end of the metatarsals, either by severing them well forward and drawing the end through a hole drilled in that part of the metatarsal, or by lifting a flap of periosteum and cutting a groove on the dorsal surface of the bone, laying the tendon in this groove and securing it by suturing the periosteal flap over and to it (as described by Gallie and Sangiorgi).¹ A bone-flap could also be used if desired, but I believe one of the others will be sufficient to focus the ligamentous pull on the distal end of the metatarsals and obviate the threatening deformity of the toes.

This procedure is simply a combination of two mentioned operations but it will, I believe, provide the solution of the treatment of this most troublesome condition. Putti's method of fixing the tendons in the bones of the leg is safe and sure and of course can be applied to any type of paralytic deformity about the foot, such as calcaneus (using the tendo achillis and plantar flexors of the toes or the tibialis posticus or the peronei), valgus (using the tibialis anticus or posticus or both), or varus (using any or all of the peronei).

¹ This operation was completed as above outlined on December 12, 1913, with very satisfactory immediate results and there is every reason to feel that the ultimate results will be as desired as this additional work has been thoroughly tried out by many operators and has received the stamp of approval.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting, held December 1, 1913.

DR. GWILYM G. DAVIS, the President, in the Chair.

ARTHROPLASTY OF THE KNEE-JOINT.

DR. HUBLEY R. OWEN presented a paper on Arthroplasty of the Knee-Joint, for which see page 426. An illustrative case was also presented.

DR. WILLIAM J. TAYLOR said that in this case there had been suppuration, the patella was worm-eaten on the under surface, and fixed to the articulating surface of the femur, so that in order to get movement it was necessary to turn it upside-down. Flaps of fascia and fat were made, taking them from above, bringing them down between the articulating surfaces, and as they were not quite long enough to go clear through they were lapped over about one-third and stitched. The boy has a better joint than had been hoped for. The patella was sawed through obliquely in order to get the largest possible surface, and each half turned upside-down, the sawn surfaces twisted in the opposite direction, then brought together again and united by catgut sutures. This made a perfectly good, strong, bony union, with the result that the patella is now perfectly movable.

In this case the condition of the bone was such and the angle was such that it was necessary to take off quite a considerable amount of bone, particularly from the end of the femur, to get the leg straight. It is essential to take off enough of the surfaces to make the apposition between the ends of the two bones comparatively easy.

As to the question of the other joints, some years ago he had a man under his care in whom both elbows were absolutely stiff, due to an infection from his tonsils. He resected his left elbow

and gave him a perfectly useful and serviceable arm, so much so that he declined to have the other one operated upon, saying that he could get along with the one. Dr. Taylor had resected the shoulder-joint many times and the results are so satisfactory that this is the operation of choice, rather than arthroplasty.

DR. J. T. RUGH called attention to the method of arthroplasty originated by Dr. R. T. Taylor, of Baltimore, which consists in the shaping of the joint surfaces by the removal of a sufficient amount of bony material to allow free function, and then filling the joint cavity with a preparation of wax which has a rather high melting-point. The joint is then closed and movements are begun at the end of a week or ten days. He had seen some remarkable results in these cases from that procedure. It is comparatively easy of performance, the most difficult part being the removal of the joint surfaces.

DR. ASTLEY P. C. ASHHURST said that it seemed to him that a more important matter than the mere question of technic is the indication for the operation. He regretted very much that Dr. Owen cannot say whether or not this was really a tuberculous case. If he has made a tuberculous knee-joint movable with safety he would be accomplishing a great surgical feat. Dr. Ashhurst was one of those who believe arthroplasty to be contra-indicated in cases of tuberculous ankylosis. It is interesting to recall that Dr. John B. Murphy attempted arthroplasty on an ankylosed hip that was undoubtedly tuberculous, found an unsuspected abscess, and left the man, at last reports, with discharging sinuses.

Dr. Owen spoke with proper caution about the indications for arthroplasty, and though the patient he shows has a good motion (120 to 150 degrees), it would seem that in a child of twelve years supposed to have a tuberculous ankylosis in bad position, it would have been safer on general principles to have taken out a wedge of bone and thus made the knee-joint stiff and straight.

DR. GWILYM G. DAVIS thought that in spite of the successful result in this case the introduction of drainage is decidedly of service as a precautionary measure. On two or three occasions he had not used drainage and had always regretted it; by this he meant drainage for 24 to 48 hours.

Apropos of the tuberculosis question, he operated once on a tuberculous knee, and while he got some motion he did not get as much as he desired and the knee remained painful for a long, long time, and he had been inclined to be conservative since then.

In relation to the elbow-joint it is one of the most satisfactory joints for arthroplasty as well as for resection, and the results from arthroplasty are so far more brilliant than are obtained by resection.

PARALYTIC TOE-DROP.

DR. J. TORRANCE RUGH read a paper on Putti's Operation for Paralytic Toe-Drop, for which see page 432.

DR. A. B. GILL (by invitation) said that he had observed four cases in which silk ligaments have been implanted to correct paralytic foot-drop. The ligaments are put through a hole drilled through the tarsus and then passed up the leg within the sheaths of the peroneus tertius and the tibialis anticus, and then passed through a hole drilled through the crest of the tibia and fastened there. Of the four cases, one is now of two years' standing, in which the silk is still holding the foot in good position with marked improvement in the gait. One silk ligament of the four broke, owing to weakening of the silk by too prolonged boiling in the bichloride of mercury. It was an easy matter to replace the silk. The other cases are in good condition. There has been no condition of flexion of the toes resulting from the operation. It will be interesting to observe in the Putti operation when the tendon is severed above and below whether there will occur degeneration and stretching of the tendon.

DR. GEORGE ERETY SHOEMAKER expressed surprise at the use of buried silkworm gut sutures. This is a substance which was tried out very thoroughly years ago in this country and abandoned as a buried suture material, because it was absolutely unattacked by the cells of the body and always remained as a foreign body during the lifetime of the patient. A permanent suture does no more good than a temporary one, as under the slightest tension it cuts until it does no more holding. He had had occasion to take out a considerable number of silkworm gut sutures put in under perfectly sterile conditions, the sterility persisting for say two years, when the sutures would begin slowly to work their way out. He had buried many hundred worm gut sutures in aponeurotic tissue, and had seen probably one per cent. give trouble after long intervals.

DR. J. TORRANCE RUGH (in closing) said that he had mentioned the fact that Professor Putti used the silkworm gut, though he himself did not. He called his attention to its abandonment

in America and he said he never had any trouble whatsoever from it. He had used it for a number of years and he claimed most excellent results. Dr. Rugh used chromicized catgut in this case as he does in all.

In regard to the silk ligaments, he was a firm believer in their use, but anything of that kind is a foreign substance, and if you have structures which are capable of preserving the position of the foot, why introduce a foreign substance? He had done quite a number of these cases of silk ligaments for this condition of toe-drop, for valgus and for varus and had had no trouble since using the paraffin silk, but he did have trouble with bichloride silk, as it came out by sterile suppuration. The paraffin silk remains in and is very good. But here are structures which are inelastic, and already in place and if you fix them you make ligaments out of the tendons. If any change takes place, even if they lose their identity as tendons, they are still ligaments.

This operation has been done for a couple of years by Putti, who claims that they were holding splendidly, and unless the tendons should stretch, it is the ideal operation for this condition.

RADICAL CURE OF AN INCARCERATED INGUINAL HERNIA IN AN INFANT TWENTY DAYS OLD.

DR. WALTER E. LEE reported the history of an infant who was admitted, January 20, 1912, to the service of Dr. James P. Hutchinson at the Children's Hospital.

It was by the courtesy of Dr. Hutchinson that the reporter operated upon the child and had the privilege of reporting the case.

Upon admission the right half of the scrotum was found enlarged and tense and the tumor emerged from the external inguinal ring. The scrotum became normal in size after taxis when a gauze pad over the external ring with adhesive plaster and spica bandage reinforcements were applied to secure the reduction. Following this the child had three normal bowel movements and seemed perfectly comfortable for twenty-four hours when the tumor reappeared and operation was decided upon.

The skin and subcutaneous tissues were anæsthetized by infiltration with thirty minims of a four per cent. solution of eucaine. On opening the sack about one drachm of bloody fluid escaped. One large loop of small intestine, ten inches in length, with its mesentery were found in the sack and the mesentery was twisted

upon itself one complete turn. The bowel was very dark in color but the peritoneal coat lustrous, and after irrigating with hot normal salt solution, the color of the bowel improved and the circulation returned in the mesenteric vessels. The constriction was found at the internal ring and after dividing it the bowel was returned to the abdominal cavity. The aponeurosis of the external oblique and the internal oblique muscle were then sutured to Poupart's ligament with chromicized catgut, thus depressing the cord. The skin wound was closed with three silkworm gut sutures. At the close of the operation the infant vomited fecal matter and this was the first vomiting of which we had any knowledge.

The child nursed the following morning and this day there was a normal bowel movement. The convalescence was uneventful and the child was discharged with a firm wound on the twenty-first day.

Dr. Lee called attention to the satisfactory anæsthesia obtained by the local infiltration of a solution of eucaine. The anæsthesia seemed perfect during the entire operation, the infant busily sucking the thumb of the nurse.

RADICAL OPERATION FOR A HERNIA OF THE UMBILICAL CORD IN A NEW BORN INFANT.

DR. WALTER E. LEE reported the history of an infant who was brought to the dispensary of the Children's Hospital one hour after its birth. Dr. Edward B. Hodge saw the child and advised immediate operation. It was by his courtesy that the reporter operated and had the privilege of reporting the case.

The infant seemed perfectly formed except for a large cystic tumor which protruded from the anterior abdominal wall. The tumor was nearly as large as the infant's body. The circular opening in the abdominal wall, an enlarged umbilical ring, extended from the xiphoid cartilage to within one inch of the pubic bone. The skin of the abdomen was continued upon the pedicle of the sack for one-quarter of an inch, where it ended as a sharp border beyond which a transparent membrane as thin as paper covered the remaining portion of the tumor as far as its distal extremity, where the covering was drawn out like a funnel and became continuous with the ligated umbilical cord. The umbilical vessels could be felt as a cord on the lower surface of the tumor. The liver, the spleen and the large and small bowel could be clearly seen through the hernial covering floating in a clear transparent

fluid. These organs were all outside of the margin of the umbilical ring.

The child was anæsthetized with ether and an attempt made to reduce the organs. This was unsuccessful and upon opening the sack, the bowel, liver and spleen were found adherent to the sack wall in many places. After ligating the umbilical vessels and breaking the adhesions the bowel and spleen were reduced, but it was necessary to enlarge the opening in the abdominal wall by an incision toward the pubes before it could be replaced. The hernial sack was excised and the abdominal wall united with ten chromicized catgut sutures which passed through the entire thickness of the wall. The tension upon these sutures was relieved with strips of Z. O. adhesive encircling the abdomen. The increased intra-abdominal pressure resulted in a large amount of meconium being expelled at the end of the operation. The child lived for five days. During this time the bowel moved three to four times daily and it regurgitated small amounts of mucus flecked with black particles which looked like meconium. It was fed with a weak mixture of condensed milk and an attempt was made to bring some of the mother's milk to the hospital on the fourth day but the plans miscarried.

No autopsy was obtained and the cause of death remains uncertain.

Dr. Lee added that congenital herniæ of the umbilical cord should be classified as malformations since the peritoneum and viscera are not abnormally protruded but lie in front of the anterior abdominal wall as in the early stage of intra-uterine life, the normal closure failing to take place. It is really an ectopia.

The outer covering of the sack is formed by the distended tissues of the umbilical cord, a thin layer of the jelly of Wharton, and behind this is the hernial sack, corresponding in its position to the peritoneum and continuous with the abdominal peritoneum.

As the circulation in the umbilical cord ceases immediately after birth the stump of the cord becomes necrotic, shrinks up and is cast off after several days; the covering of the hernia of an umbilical cord naturally undergoes the same fate, exposing the abdominal viscera, the consequent suppurative peritonitis usually causing death.

Radical operation was first advocated by Lindfors in 1881. Hansson published a collection of 73 cases treated in the antiseptic method, 1900. Mortality of 32.8 per cent.

DESTRUCTIVE PELVIC LESIONS ASSOCIATED WITH CHRONIC DIVERTICULITIS.

DR. GEORGE ERETY SHOEMAKER read a paper with the above title, for which see page 422.

THROMBO-ANGIITIS OBLITERANS (BUERGER'S DISEASE).

DR. PENN G. SKILLERN, JR., said that thrombo-angiitis obliterans of the lower extremity is the designation proposed by Buerger (*Am. J. M. Sci.*, 1908, N. S. cxxxvi, 567) for the condition formerly known as "endarteritis obliterans," "arteriosclerotic gangrene" and "Spontan-gangræn" of the Germans, and is based upon conclusions drawn from pathological studies of the vessels obtained from nineteen amputated limbs. In brief, we are dealing with a thrombotic process in the arteries and the veins, followed by organization, and not with an obliterating endarteritis. Most of the larger arteries and veins of the amputated limbs were found obliterated over a large extent of their course. The veins share equally with the arteries in the lesion of occlusion, and may even be more extensively involved. The distal parts of the vessels, rather than the proximal, are closed. At times, 2 to 4 inches of a vessel's length is closed, while the portions above and below are apparently normal. There is often an involvement of some of the smaller branches, such as the tarsal and the metatarsal, but the smallest arteries are free. The process involves the intima, the media, the adventitia, and the perivascular tissues. The periarteritis is a fibrous agglutinative process that binds together the artery and its collateral veins, and sometimes also the accompanying nerve, so that the liberation of the individual vessels by dissection is difficult. The cause is probably partly static and partly toxic.

The disease usually attacks Polish and Russian Jews between the ages of twenty and thirty-five or forty years, so that the names juvenile and presenile gangrene have been employed. After longer or shorter periods, characterized by pain, coldness of the feet, ischæmia, intermittent claudication, and erythromelalgic symptoms, evidences of trophic disturbances appear which finally pass over into a condition of dry gangrene. The left leg is usually the first to become affected, and when simultaneously bilateral the diagnosis of Raynaud's disease is often made. In the pendent position a bright red blush comes on the toes and foot. Soon a blister, hemorrhagic bleb, or ulcer develops near the tip of one

of the toes, usually the big toe, and frequently under the nail, and when this condition ensues the local pain becomes intense. Even before the gangrene, at the ulcerative stage, amputation may become imperative because of the intensity of the pain.

The following case illustrates with great fidelity most of the features described by Buerger.

M. L., male, Hebrew, aged forty-two, sheet-metal worker, presented at the Surgical Out-patient Department of the University Hospital, service of Dr. B. A. Thomas, July 17, 1913, complaining of intense pains in both legs of a year's duration. The pain in the left leg is greater, and is constant, night and day. It is chiefly burning in character.

Examination revealed both feet involved in ischæmia, obliteration of pulse or dorsalis pedis on both sides, and a dusky blush involving both great toes. A trophic ulcer beneath the nail of the left great toe exposes the end of the ungual phalanx.

Nerve-stretching had been performed in another city without relief, and everywhere the patient went amputation was advised as the only method of relief from the wearing pain. Examination of the distribution of the pain showed that it was confined chiefly to the area presided over by the cutaneous filaments of the musculocutaneous nerve. It was figured out that if this nerve were resected, amputation could be postponed indefinitely, and the patient allowed to retain the otherwise useful limb—at least until extensive development of gangrene indicated amputation. Accordingly, using a solution of novocaine two per cent., with adrenalin 1 to 3000, intradermic infiltration along a transverse line 2 inches broad with centre over antero-external border of fibula, was made 4 inches above the base of the fibular malleolus. The cutaneous division of the musculocutaneous nerve was exposed at its emergence from the deep fascia, and a section one inch long was excised. The relief from the burning pain was *immediate*. The wound was drained by a folded strand of silkworm gut. It was closed by 4 silkworm gut sutures, and a dilute alcohol dressing applied.

The day after operation there was no pain in the foot. Reports upon the blood and the urine, which had been previously collected, showed that the Wassermann reaction was negative and that there was no sugar. The patient was given 5 drops of a saturated solution of the iodide of soda and one one-hundredth of a grain of nitroglycerin three times a day after meals.

Owing to the impoverished circulation of the limb, the operative wound remained indolent for several weeks, but was eventually stimulated to heal by the application of Bier's powder of nitrate of silver and powdered clay.

A month after operation the patient complained of pain in the distribution of the anterior tibial nerve to the adjacent sides of the great and of the second toes. This nerve was reached in the first interosseous space by a hypodermic needle, and was blocked with alcohol. This sufficed to relieve the pain.

DR. MORRIS BOOTH MILLER said that he had had some experience with Buerger's disease and had been very much interested in Dr. Skillern's account of the relief of pain by the severance of the musculocutaneous nerve. These cases are most distressing, the patients suffering at all times, especially during cold weather. He was surprised at so much benefit having resulted from cutting a single nerve; his observations would have made him believe that the severance of the whole nerve trunk would be necessary. Within the last ten days he had seen another complication which may occur, a man upon whom he had operated at different periods for Buerger's disease was stricken with a cerebral embolus. The diseased condition is one of vascular change involving all parts of the blood-vessels, both arteries and veins, and of the structures outside of the vessels, thereby affecting the nerves. This process is not a continuous one; it seems to show periods of rest, when the patient will be nearly free from pain though showing distinct objective symptoms, and then there will be an increase of all symptoms corresponding to new and further vascular change. In the case mentioned of cerebral embolus the man had just suffered an augmentation of this phenomenon.

DR. DUNCAN L. DESPARD said that he had had an opportunity of operating on a number of these cases and then following them by microscopic examination of the vessels. In regard to the cause of the condition he had been struck by the proliferation in the intima and the elastic tissue which takes place in these vessels and frequently without obliteration of the lumen of the artery. He did not think that the obliteration by a thrombus is entirely to be accepted as the cause. He had a case last summer, of a man who suffered greatly. Since June applications of X-rays, two or three times a week, had been made. As a result he has obtained a great deal of relief from his pain. It has passed entirely from his toes and legs and he now complains of pain in the region of the

knees, which have not been subjected to the X-rays. Strange to say, the temperature of the legs has increased. They were cold during the summer and the other day there was a perceptible increase in the local temperature to the hand. Whether he will have continued relief or that this is simply a temporary improvement, remains to be seen.

DR. GEORGE P. MÜLLER said that he had seen a great many of these cases, mostly in Dr. Frazier's Clinic in the University Hospital. A number of years ago the affection seemed to be limited to the great toe, and was commonly known as Mitchell's disease, but in recent years they have observed more cases in which the entire foot or even the leg was involved. He did not know that they had obtained any permanent relief by any method of treatment short of amputation. They have stretched, injected, and cut the internal saphenous or external cutaneous nerves, and have had X-ray treatment used, and high frequency current, etc. In two cases he performed arteriovenous anastomosis and in another he tried to do so but found the femoral artery a solid cord. He was not an advocate of this method of treatment and cannot agree with the enthusiastic claims of Wieting, Bernheim, and others. They have resorted in at least two cases to amputation. These amputated limbs were examined in Dr. Speese's Laboratory and there was distinct evidence of thickening of the femoral vessels and more or less thrombosis in the veins.

DR. NATHANIEL GINSBURG (by invitation) said that for some time he had been interested in this subject, because of the almost sole limitation of this affection to a single race—the Jews.

Continued observation of young Russians, who have recently come to this country, with the idea of determining whether it is a purely peripheral condition, has convinced him that this disease possesses a symptom complex of which the peripheral state is only a part. As an example, he has been observing now for the past five years a young man of about twenty-four years of age, who presents marked disturbance of the circulation in his hands and feet. Examination of his surface blood-vessels reveals very feeble pulsation in his brachials, axillary and femoral arteries, indicating a general vasomotor constriction of all these blood-vessels. The maximum effect is first felt in the digits of both upper and lower extremities, which become the seat of trophic changes, very often necessitating amputation of the part. While Buerger has established the pathology of this condition as far as the peripheral ves-

sels are concerned, possibly Dr. Mitchell was correct, when many years ago he suggested the spinal cord as primarily the seat of the trouble, since theoretically stimulation of the sympathetic motor neurons of the cord will produce marked peripheral vasomotor constriction of the blood-vessels.

The relationship of this condition largely confined to a single class of people may be explained upon the basis which Dr. Crile has enunciated in his theories underlying the production of shock. This disease is found in a highly emotional class, subject to tachycardia, and neuroses of every description, and who suffer post-operative shock to a greater degree than any other class of patients. They are more subject to sensory stimulus, and therefore react to a greater corresponding degree; hence the great variations in blood-pressures observed in the same patients at different times. It would seem that an important predisposing factor in the production of this condition is something in the physiological make-up of these patients, not any previous article of diet, but perhaps an unusual sensitiveness of their cerebral or spinal motor neurons acting upon the blood-vessel wall.

DR. PENN G. SKILLERN (in closing) said that in regard to the entire relief from pain in this case it might be explained by the pain being confined to the distribution of the cutaneous division of the musculocutaneous nerve. The process described by Buerger involves the intima, the media, and the adventitia together with the perivascular tissues, one huge cicatricial mass from the lumen out to the muscles. The veins are equally involved and that is why any attempt at arteriovenous anastomosis fails. This condition is not to be confused with Raynaud's disease, which is a *functional* disturbance. The kinetic theory of Crile, suggested by Dr. Ginsburg, does not explain in any way this cicatricial mass of blood-vessels. The cause is most likely a toxæmia somewhere in the body, and the predilection of the disease for the vessels of the lower extremity is determined by the static strain to which they are constantly subjected.

EPIPHYSEAL-METAPHYSEAL FRACTURES.

DR. PENN G. SKILLERN, JR., called attention under the above heading to partial fracture of an epiphysis or of the adjacent portion of the shaft, latterly designated the metaphysis. This injury is not to be confused with the well-known epiphyseal injuries that

have been classified by Ollier as paraepiphyseal strains, paraepiphyseal sprains, and disjunction of epiphyses.

Illustrative of partial epiphyseal fracture is the following case:

M. E., male, aged four and a half years, while riding a bicycle was run into the curb by a coal wagon and fell off, injuring the right knee. Skiagram (Fig. 1) shows the separation of a small unciform fragment from the tibial side of the lower epiphysis of the femur. Gypsum case was applied. This fragment shows equally well in lateral view (Fig. 2). It will be noted that it was caused by *direct* violence, and therefore is not a true tear-fracture.

Illustrative of partial metaphyseal fracture is this case:

W. G., male, aged five, fell off the porch, injuring the right elbow. Examination 4 days later revealed swelling, tenderness and lemon-yellow ecchymosis about the external condyle. Skiagram (Fig. 3) showed partial fracture of the external corner of the lower metaphysis of the humerus, with but trifling displacement. The arm was dressed on an internal right-angle splint. This injury was also produced by direct violence.

In addition to these epiphyseal and metaphyseal fractures by direct violence, it is conceivable that tear-fractures of the metaphysis might arise from overstretching of a part of the articular capsule, or of one of its specially thickened bands, or ligaments. Tear-fractures of certain epiphyses, to which ligaments are attached, could also occur, in which event the epiphyseal bond of union is stronger than the ligamentous.

EXTENSIVE COMMINUTED FRACTURE OF THE LOWER THIRD OF A HUMERUS STUMP.

DR. PENN G. SKILLERN, JR., presented the following case more as a surgical curiosity than for any other reason.

C. W., male, aged thirty-three, clerk, fell backward, landing on the lower end of the stump of the left humerus. Clinical examination revealed swelling, preternatural mobility, crepitus and tenderness in the lower third of the humerus. Skiagram (Fig. 4) revealed comminution of the shaft of the left humerus, just above the lower end, into a dozen small fragments, with vertical splitting of the shaft. This was dressed upon an anterior and a posterior splint.

Sixteen years previously disarticulation at the left elbow-joint was performed for a gunshot injury to the forearm. Two years ago he fell, and had a clean transverse fracture of the same stump.

FIG. 1.



Partial fracture of lower epiphysis of femur. Anteroposterior view.

FIG. 2.



Partial fracture of lower epiphysis of femur. Lateral view.

FIG. 3.



Partial fracture of lower metaphysis of humerus.

FIG. 4.



Extensive comminuted fracture of lower third of humerus stump.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

*Stated meeting, held at the New York Academy of Medicine,
November 26, 1913.*

DR. CHARLES H. PECK, President *pro tem*, in the Chair.

VENTRAL HERNIA.

DR. ARTHUR S. VOSBURGH presented a woman, forty-four years old, who was admitted to Bellevue Hospital on September 17, 1913, suffering from a recurrent ventral hernia. Four years ago she had been operated at the Harlem Hospital for an umbilical hernia, and during her stay in that hospital a second operation was performed and an "eight-pound tumor" removed. Since then she had not menstruated.

Examination showed a large ventral hernia situated in the scar of the former operations. The mass, which was irregular and only partly reducible, presented several openings in the fascia. On September 19, 1913, under ether, the old scar was circumscribed and the peritoneum opened at a favorable point. The dissection of the intestines from their attachment to the old cicatrix was long and difficult. The intestines were held in a mass by broad adhesions. These were not disturbed, but all narrow bands were divided. The irregular openings in the fascia, one at the former location of the navel, the others nearer the pubis, made it impossible to do a Mayo overlapping operation, and the repair was accordingly made by coaptation obtained from side to side. Folded rubber tissue drains were inserted, a small dressing was applied along the line of suture, with broad bands of adhesive plaster incircling three-quarters of the trunk, covered by heavier dressing and an abdominal binder. The patient's

recovery was normal, excepting for a discharge of liquid fat for a week or ten days and a slight attack of pleurisy during the second week of her convalescence.

Dr. Vosburgh presented a second case of ventral hernia in the person of a woman, thirty-four years old, who was admitted to Bellevue Hospital on October 18, 1913. She was the mother of twelve children, and about six years ago, after the birth of a child, she noticed that there was a protrusion in the median line which increased in size with each subsequent pregnancy. On admission, the patient, a large, fat woman, presented an abdominal tumor of huge dimensions. In the recumbent position this was easily reducible, and disclosed a separation of the recti from a point four inches above the navel to within an inch or two of the pubes. The gap between the muscles was large enough to insert two fists side by side.

The operation in this case proved comparatively easy, occupying less than an hour. A large, elliptical section of integument and fat, together with a corresponding section of the fascia, much thinned, was removed. No adhesions were found, but the recti could not be made to meet by several inches and their sheaths were not opened. The repair was made by the Blake overlapping method, in the same manner as in the first case. The fat having been carefully removed from the left flap, it was drawn underneath the right flap by mattress sutures. In order to preserve the blood supply of the superficial flap, its fat was not removed, while the peritoneum and the pro-peritoneal tissues were depended upon to take care of the nutrition of the deeper flap. The wound was dressed in a manner similar to that in the first case; it healed by primary union and the patient was discharged on November 12, 1913.

Blake's method of treating this form of hernia, Dr. Vosburgh said, was described in *The Medical Record*, May 25, 1901. In his second case reported in that paper he did not dissect free the peritoneum, but included it in his flap. The Mayos' paper on umbilical hernia, published in the *Jour. of the Amer. Medical Association*, July 25, 1903, emphasized the importance of the dissection of the peritoneum and its independent suture, the deeper fascial flap being received in a pocket, as it were, of the superficial flap and its peritoneum.

MULTIPLE OSTEOMYELITIS OF FIFTEEN YEARS' DURATION, CURED BY AUTOGENOUS VACCINES.

DR. A. V. MOSCHCOWITZ presented a man, thirty-two years old, who, seventeen years ago, suffered from an acute febrile disease, which, after three weeks' treatment at home, was diagnosed as osteomyelitis of the right femur. He was then admitted to the Mt. Sinai Hospital, and after repeated and very extensive local operations, an exarticulation at the right hip-joint finally became imperative. During the following fourteen years, the disease successively involved the left lower jaw, the left malar bone, the right humerus, the left tibia, the left elbow-joint, the left ankle-joint and the lower part of the left femur, and in addition to these bone infections, there occurred also several subcutaneous, intermuscular and intramuscular abscesses. In every instance the infective agent was the staphylococcus aureus, which was also recovered from the blood. The patient was unable to state precisely the number of operations he underwent, but there were at least forty.

Finally, he was readmitted to Mt. Sinai Hospital on March 28, 1911, with an extensive osteomyelitis of the upper two-thirds of the left femur. This was operated on, and from the pus the staphylococcus was again cultivated. From this, an autogenous vaccine was prepared, and during his stay in the hospital he received several billions of cocci subcutaneously. Two years and nine months had elapsed since that time, and in view of the fact that the longest period during which he had hitherto remained free from an acute exacerbation was only eight months, the speaker thought he might now be confidently presented as a cured case.

ADAMANTINOMA OF THE JAW.

DR. ALFRED S. TAYLOR presented a man, thirty-seven years old, whom he had already shown at a meeting of the Society in 1909, after the second operation for an adamantinoma of the jaw, the first having been done in 1905.

In October, 1913, when the patient returned with a recurrence of the growth, about the size of an English walnut, it was evident that the lower jaw was so much eroded that further palliative procedures were out of the question and that a resec-

tion was imperative. The question naturally arose whether to do a primary bone transplant or a secondary one. The objection to the former was that there would be an open communication between the transplant and the wound in the mouth, but inasmuch as the only risk involved would be the loss of a few inches of one of the ribs, this method of procedure was decided upon, and on October 16, 1913, the involved section of the lower jaw was removed, extending from the second bicuspid back to the angle of the jaw, and including all the diseased bone, together with the soft tissues beyond the limits of the tumor. Silk sutures were inserted in the mucous membrane, three layers of catgut sutures beneath, and every precaution was taken to protect the wound from the mouth secretions. The tenth right rib was then exposed, and a section, together with its outer periosteum, was removed, and after trimming it to the proper size, it was inserted to fill the gap in the lower maxilla. A hole was bored in the jaw anteriorly with a Hudson drill and the anterior end of the rib pushed into it like a dowel. The posterior end of the rib was split vertically and made to fork over the lower end of the ramus of the jaw. This arrangement made a mechanically firm new jaw.

On the ninth day after the operation the wound showed some evidences of infection, due to communication with the mouth. But in spite of this the transplant remained firm. Six weeks had elapsed since the operation, and while there was still a small amount of discharge, the bone transplant gave evidence of being permanent, with preservation of excellent function of the jaw. Pathologically, the tumor was an adamantinoma. X-ray pictures, taken after six weeks, showed the piece of rib still in perfect condition, and in the position originally placed.

PITUITARY TUMOR: FRAZIER OPERATION.

DR. JOHN F. ERDMANN presented a girl of fourteen who was admitted to the hospital on June 10, 1913, complaining chiefly of a loss of vision, which was practically complete, the patient being scarcely able to discern between daylight and darkness. Her family history was unimportant. In childhood, the girl had whooping-cough, measles, scarlatina and pleurisy, and she had suffered from occasional attacks of tonsillitis. Her present trouble began in February, 1913, when she first noticed that she could not read properly, often missing or repeating words and

lines, and when reading she noticed that the left side of the book would become blurred. For three months previous to that time she had noticed that she could not see the blackboard from her seat in the rear of the school-room, and she was finally compelled to move to the front row of seats in order to see what the teacher was writing. The eyesight gradually grew worse, and in February she was compelled to leave school. Two months later she awoke one morning practically blind, and since then she has had continuous visions of different objects before her eyes. In April she began to complain of severe headaches, especially on the left side. These were only temporary. Her appetite was fairly good and she slept well. She suffered from constipation; also occasional vomiting, accompanied by nausea and vertigo. An examination of the eyes made by Dr. John E. Virden showed complete double optic atrophy.

Five weeks ago, Dr. Erdmann said, he operated on this patient by the Frazier method. Upon exposing the frontal lobe, he found a large collection of fluid between the dura and the arachnoid, which was removed by puncturing the dura. Upon exposing the sella turcica it was apparently slightly enlarged, and in the region of the floor of the sella a dark, grayish object protruded, resembling portions of a cyst wall. This was extirpated as completely as possible, and the wound closed.

For four or five days following the operation, the patient was very irritable, with a temperature ranging between 103° and 106° . This gradually subsided, and she left the hospital two weeks later. At the present time the optic atrophy was still apparently complete, although the patient insisted that she could at times distinguish certain objects.

Pathologically, the specimen showed disintegration of the structure of the pituitary body, with fairly well marked chronic inflammatory changes and localized areas of hemorrhage. There was a considerable development of hyaline connective tissue, which formed the wall of the "cyst," and passed through both the anterior or prehypophysis and the intermediate portions of the gland. The lymphoid cells and some polynuclears also suggested the presence of inflammation. The normal histology of the gland was greatly distorted, and the epithelial cells of the anterior lobe were compressed. In some sections there were areas

of fibrinous-like material and œdema. There was no histological evidence of tumor formation, the changes being of a degenerative and inflammatory character.

TUMOR OF THE HYPOPHYSIS.

DR. CHARLES A. ELSBERG presented a man, thirty-seven years old, who came under his observation in January, 1913, being referred by Dr. Emil Gruening. For two years the patient had complained of increasing deterioration of vision, without other symptoms. Dr. Gruening's examination showed that there was a temporal hemianopsia and a much contracted visual field on the left side, and that only slight light perception remained in the right eye. X-ray showed marked enlargement of the sella turcica.

The patient was operated upon by Dr. Elsberg at the Neurological Institute in February. The hypophysis was exposed by the transfrontal route of Frazier, and a tumor of the hypophysis—part of which surrounded the optic chiasm—was found. A large piece of the tumor was removed and proved to be an adenoma. Convalescence from the operation was uncomplicated and eyesight began to improve within 48 hours of the operation. The left field of vision steadily improved and most of the temporal defect has disappeared, while the sight of the right eye has not returned. The patient has been able to return to his work as a tailor, and is again able to sew and to read the newspaper. The scar from the operative incision is only slightly noticeable.

Dr. Elsberg presented a second case, in the person of a boy upon whom operation was done six months ago.

The patient had, for one year, increasing loss of sight in both eyes with frequent attacks of headache; he was referred to the speaker by Dr. Jelliffe. Examination showed that the left eye was blind, and that there was a temporal hemianopsia with markedly contracted field of vision of the right eye. X-ray examination showed a decided enlargement of the sella turcica, the posterior clinoid processes having entirely been destroyed.

Dr. Elsberg operated upon the patient, who was a very frail child, at the Neurological Institute, and exposed the sella turcica by the transfrontal route as modified by himself.

There was a marked collection of the fluid on the under surface of the left frontal lobe, and after this had been evacuated, further manipulations were deferred to a second stage. The bone

flap was returned into place and the wound closed. The improvement in eyesight was very marked and the temporal defect in the right eye has been steadily growing smaller, so that further operative interference has been put off indefinitely. The improvement is undoubtedly due to the decompressive effect of the operation. If necessary, a second operation will be done.

Dr. Elsberg also showed a patient from whom he had removed a mucous cyst from the frontal bone, with very satisfactory result, the deformity due to dislocation of the eyeball having entirely disappeared, and the scar being barely visible.

In connection with the first two patients presented by Dr. Elsberg, he made some remarks upon operations for exposure of the hypophysis, and stated that he believed that the transfrontal route suggested by Dr. Frazier, of Philadelphia, was an excellent method for exposing the contents of the sella turcica. The operation is not at all difficult, and the surgeon obtains an excellent view of the hypophysis—as good a view as one ordinarily obtains of the Gasserian ganglion in operations for removal of the ganglion or division of its sensory root.

The speaker described the modifications of Frazier's operation that he has adopted. These consist of removing part of the supra-orbital margin together with the bone flap and of making the base of the osteoplastic flap in or near the median line and thus avoiding an incision on the forehead. It is not necessary to remove part of the supra-orbital margin separately, but it can easily be included in the bone flap. The advantage of this is that there is no danger of necrosis of the supra-orbital margin when it is later replaced.

The speaker declared it as his belief that in properly selected cases the transfrontal operation was superior to any of the intranasal methods of approach, because the latter were, in the majority of instances, only decompressive operations.

FRACTURE OF THE ACROMION PROCESS OF THE SCAPULA.

DR. WILLIAM DARRACH presented a man, fifty years old, who on May 12, 1913, was struck by a railroad train, receiving a fracture of the skull, of the lower extremity of the humerus and of the scapula. After three months' treatment in various hospitals he came to Roosevelt Hospital, August 20, 1913, complaining of limitation of movement at the shoulder and elbow. The humerus

showed a T-shaped fracture with tremendous callus formation. By removing a portion of the latter from the region of the capitellum his flexion was increased 15° . There was but 30° of abduction at the shoulder with marked loss of power. Examination showed a fracture of the acromion process at its junction with the spine with very free motion between the fragments, the outer one having an excursion of one inch. On cutting down on the site of fracture, the fragments were found widely separated and joined by a band of firm connective tissue. The latter was cut away and the bone edges freshened. Holes were bored and two heavy twisted silk sutures passed, holding the fragments in good apposition. The shoulder was immobilized for four weeks. At the end of that time union seemed solid. Two months later there was no motion between the fragments and the motion at the shoulder had markedly increased. X-ray showed the fragments to be in close apposition.

DR. BURTON J. LEE said that about a month ago he saw a similar case where the accident had occurred as the result of a football injury, with about as much displacement as in the case shown by Dr. Darrach. He made a vertical incision from the acromion to the tip of the coracoid process, and finding that the clavicle could not be replaced without removing the interarticular fibrocartilage, removed the latter structure. He then roughened the articular surfaces to secure at least fibrous union and passed two kangaroo ligatures through the coraco-acromion ligament and the clavicle and a third about the clavicle and through the coracoid process. The division of a few fibres of the trapezius at the outer part of the posterior margin of the clavicle seemed to be an essential feature of the operation. About four weeks had elapsed since the operation, and while the deformity was absolutely done away with, it was still too early to speak of the ultimate outcome as regarded function.

DR. CHARLES H. PECK said that several years ago he had a case where he inserted a Lane plate between the outer end of the clavicle and the acromion process, with the idea in mind of removing the plate later, if necessary. It held the parts in absolute apposition, and when it was removed, about two months later, restoration of function was very perfect, and there was no tendency toward a return of the deformity.

SUBHEPATIC ABSCESS FOLLOWING OPERATION FOR
ACUTE APPENDICITIS.

DR. BURTON J. LEE presented a boy, seventeen years old, who was admitted to Dr. Roger's service in Bellevue Hospital on August 3, 1913, about 9 P.M., and operated upon the following day by Dr. Rogers. Upon opening the abdomen a markedly gangrenous appendix was encountered lying in an abscess cavity which contained about two ounces of pus.

Following the operation, the patient's temperature ranged between 99° and 103° ; his pulse between 96 and 100. He complained of pain in the region of the wound and looked sick and miserable. His tongue remained heavily coated and his appetite was poor. His bowels responded satisfactorily to catharsis. On palpation, the abdomen was soft, without distention or tenderness, and examination of the wound itself on several occasions failed to reveal any definite pocketing of pus. His blood count, made two and a half weeks after the operation, showed a leucocytosis of 32,000, with 92 per cent. of polynuclears, and this blood picture remained quite constant for a month after the operation. During this entire period the boy was steadily going down hill, with gradual loss of flesh, a weak, soft pulse, usually over 100, and an appearance indicating more and more sepsis.

A radiographic examination, made by Dr. I. S. Hirsch three weeks after the operation, gave the following results: The chest showed the diaphragmatic shadow on the right to be considerably elevated, indicating a possible subphrenic condition. Physical examination of the chest was negative. A month after the original operation an area of definite tenderness was first made out just above the wound, directly below the right costal margin, at about the level of the ninth costal cartilage. No tenderness could be elicited by deep pressure in the right flank.

As the patient's condition was steadily growing worse, an exploratory operation was decided on, and this was done by Dr. Lee on September 3, 1913. An incision was made roughly parallel to the costal margin on the right side, over the tender area, the rectus muscle being cut across and the peritoneum opened. The liver edge was recognized, and an exploring finger passed just beneath the liver, and above the hepatic flexure encountered adhesions. Upon breaking through these adhesions, an abscess

cavity was opened containing a few ounces of thick, yellowish pus, with foul odor. This cavity did not, apparently, connect directly with the original abscess cavity in the appendicular region. Drainage was secured with a cigarette drain and rubber tube. The boy's recovery was without further incident, and he was discharged from the hospital on October 20, 1913, with both sinuses healed and in good physical condition. At the present time his health was excellent and the wounds seemed firm.

INTESTINAL ADHESIONS FOLLOWING APPENDICITIS.

DR. HENRY H. M. LYLE presented a girl who was originally operated upon at St. Luke's Hospital on September 26, 1911, when a chronically inflamed appendix was removed. She made an uneventful recovery and returned home. Subsequently, symptoms of partial intestinal obstruction developed; these gradually became more pronounced and she returned to the hospital eight months later, suffering from what was supposed to be post-operative adhesions, which were attributed to the use of iodine on the skin at the time of the operation, for at that time no precautions were taken to protect the iodized skin. In the second operation no iodine was used. There were no adhesions to the abdominal wall, but the omentum had bound the ascending colon and cæcum to the transverse colon. This was freed, the raw surfaces were covered and the area touched with albolene. No abdominal pads were used.

Within a month a similar train of symptoms developed and the patient returned for a third operation. This time they were certain that the iodine was not to blame, and from the nature of the symptoms they concluded that they had to deal with the same condition. The third operation was performed in September, 1912. Precisely similar conditions were encountered and they were treated in the same way, excepting that the patient was placed on her left side, with her right side up, and was kept in that position. This time she made a perfect recovery and had since remained well.

Dr. Lyle said he had had occasion to reopen some of his own abdominal cases, as well as those of other surgeons, and in studying them he had been struck by the frequency with which the above conditions were found, and this had led him to place all clean cases on the left side, with the right side up, and keep them

in that position for five or six days. At the present time they were carrying on some work in the X-ray laboratory with the object of demonstrating the value of that position after certain abdominal operations.

DR. PECK said he was quite firmly convinced that iodine peritonitis did occur from time to time, and he recalled two instances where he thought that absolute proof of that fact had been found. In one of those cases there was an immense mass of adhesions which he attributed to contamination with iodine. About the same time he operated on another case, an inoperable carcinoma of the rectum, where death occurred within two weeks and where the autopsy showed plastic adhesions in all parts of the peritoneal cavity, which had been contaminated with iodine at the time of the operation by exploration with the gloved hand, while regions not so invaded were entirely free from adhesions.

Dr. Peck said that since that time he had seen several cases with extensive intra-abdominal adhesions which he thought could be ascribed to the use of iodine.

DR. PARKER SYMS thought the suggestion made by Dr. Lyle was a very valuable one, but as to the cause of post-operative adhesions, he was inclined to attribute them to peritonitis, most probably due to a more or less mild type of infection. Of course peritonitis may be due to a chemical irritant.

The only case of this kind that has come under his observation in the last few years happened to be one of the few cases in which he has not used iodine in the preparation of the skin.

DR. LYLE, in reply to a question, said that while he had abandoned the use of iodine in these cases, the post-operative adhesions in the case he had presented were apparently not the result of the iodine, as had been demonstrated by keeping this patient in the left lateral position after the third operation. In using iodine, if the bowel came in contact with the skin, it had been shown that the former gave the iodine reaction.

DR. MOSCHOWITZ said that at the Mt. Sinai Hospital he used iodine only in those cases where there were special indications for it, such as a sinus infection. In other cases they depended on soap, ether and bichloride. Personally, he had seen iodine produce an annoying dermatitis, particularly where it came in contact with the adhesive plaster.

DR. ERDMANN said that after a very extensive use of iodine preliminary to abdominal operations during the past three years, numbering at least 300 patients, he had only seen a dermatitis produced in two, and in those cases where it was used in connection with adhesive plaster, there was less irritation underneath the plaster than outside of it. He could not recall a single instance where post-operative intestinal adhesions could be attributed to the use of the iodine. In the application of the iodine, the speaker said, they had dispensed with the preliminary swabbing with benzine.

DR. WILLIAM A. DOWNES said he had used the iodine for the past three years, since Dr. Gibson read his paper on the subject before the Surgical Society, and his results had been practically in accord with those of Dr. Erdmann. In the use of the iodine, no friction should be employed, either at the time of its application, or when the operation is completed, such as is produced by the use of alcohol on gauze in the effort to remove the excess of iodine remaining on the skin. The skin surface should be dried gently before dressings or adhesive plaster are applied and blistering will practically never occur.

DR. ELSBERG said he had used iodine for a number of years in practically all kinds of operations, and his results had been very satisfactory. In the beginning, he had been conservative in using the method, but with increasing experience, he had come to the conclusion that iodine sterilization was both safe and efficient. In abdominal operations, however, procedures should be adopted which would prevent the iodine being carried to the peritoneal coverings of the abdominal viscera which would result in the formation of adhesions. This can be satisfactorily accomplished by fixing towels to the edges of the peritoneal surfaces by means of small clamps.

DR. PECK said that if the skin was properly protected and the peritoneum was guarded against contamination, there was comparatively little danger of resulting post-operative adhesions. On the other hand, such adhesions might result from the use of the iodine without the knowledge of the surgeon unless they were subsequently brought to his attention accidentally, as they undoubtedly are absorbed within a few weeks, and generally produce no symptoms.

THORACIC ANEURISM TREATED WITH MERCURY AND SALVARSAN.

DR. WILLIAM C. LUSK showed five cases of thoracic aneurism which had been treated with mercury and salvarsan, the details of which are reported in his paper read at this meeting. Cases I, II and III, early in their treatment, had been given a significant amount of potassium iodide besides, which was stopped, however, when the existence of an incompatibility between it and salvarsan was believed to have been observed. The first four of these cases were the same ones that he had shown before this Society just one year ago, as results of the operation of wiring with electrolysis. These four cases were all of them to-day much stronger and healthier, capable of much greater activity, and freer from the sense of impending return of symptoms, than they were a year ago, and were now possessed with a sense of well being not then entertained.

Case I had in the year's interval nearly strangled a number of times, and now he was able to walk easily a mile and a half a day. Cough and expectoration were very little and he slept all night. He had not been able to work.

Case II a year ago, taking mixed treatment, was working as bar-tender in comfort as long as he was taking his mixed treatment, but whenever he stopped his medication pain would recur, usually following exertion. To-day he has much greater physical endurance, being in excellent health, standing all day in the bar, walking about two miles a day, and the only thing that has recently excited a little pain has been when he has walked a little fast as far as seven or eight blocks, the pain subsiding as soon as he rests.

Case III, who has always been capable of greater physical exertion than any of the others, after having had mixed treatment followed by neosalvarsan, during last spring and summer undertook considerable labor of quite a heavy nature. His excessive exertions would always end sooner or later in producing temporary pain. In June he spat up blood in mouthfuls. In October and early November, during which time he was not strenuously employed, he had a little pain for an hour or two a day, probably the result of his physical excesses during the summer. On November 15 he walked ten miles without any pain resulting. His

Wassermann, which last February had become negative, has recently become mildly positive again.

Case IV was one who after his wiring (October 1, 1912) neglected to take mixed treatment and pain began to recur in about ten weeks. The few doses of mixed treatment which he was induced to take helped his symptoms, but he got worse until neosalvarsan was administered (April and June, 1913), after which his symptoms were relieved and his power of endurance greatly increased. He had no trouble all summer, doing light work in a club, and walking three or four miles a day. Early in September he began to have occasional pains, which with injections of mercury salicylate and two small doses of salvarsan, have now practically disappeared again.

Case V came under observation the end of August with a huge aneurism $6\frac{1}{2}$ inches broad and 4 inches high, projecting from the upper part of the thorax and base of the neck, which had first put in its appearance five months before. With intramuscular injections of mercury salicylate and small doses of salvarsan, the tumor had increased in size only one-quarter inch in its vertical diameter, the tension and expansibility were both much diminished, and the pain, which before was continuous, was now very slight and dependent upon posture.

THE ANTISPECIFIC REMEDIES IN THE TREATMENT OF THORACIC ANEURISM.

DR. WILLIAM C. LUSK read a paper with the above title.

BOOK REVIEW

A MANUAL OF SURGICAL TREATMENT. By SIR W. WATSON CHEYNE, Bart., C.B., D.Sc., LL.D., F.R.C.S., F.R.S., Hon. Surgeon in Ordinary to H. M. the King; Senior Surgeon to King's College Hospital, and F. F. BURGHARD, M.S. (Lond.), F.R.C.S., Surgeon to King's College Hospital, and Senior Surgeon to The Children's Hospital, Paddington Green, London. New (2d) edition. Thoroughly revised and largely rewritten. In five octavo volumes. Lea & Febiger, Publishers, Philadelphia and New York, 1913.

Volumes I to IV have already been reviewed in the *ANNALS OF SURGERY*; Volume V is now before us. It treats of (1) surgical affections of the pancreas, liver, and spleen (6 chapters); (2) surgical affections of the neck (7 chapters); (3) surgical affections of the breast and thorax (10 chapters). The rest of the book, nearly 400 pages, is devoted to affections of the genito-urinary organs.

The high standard attained in the previous volumes is fully maintained in this valuable and interesting work. Too much praise cannot be expressed for the thoroughness and soundness of the work and the clearness with which the practical side is emphasized. The work is unique in its scope and can be consulted to advantage by even the most experienced, and the beginner will find it a regular treasure-house of useful information.

The only section that does not compare quite favorably to the rest of the book is that devoted to affections of the genito-urinary organs. Here, the procedures and armamentarium recommended are in many cases much behind the time. We note with some regret that, like many other distinguished operators, the senior

author has yielded to the temptation of describing a new method of performing nephropexy.

The thorough revision of the first edition of the book with admirable condensation and the great pains taken to bring it up to date, whilst avoiding the pitfalls of new and untried measures, gives this splendid work a place in our surgical literature which will last for a long time.

CHARLES L. GIBSON.





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